ELECTRICAL WORLD

FEBRUARY 13, 1932
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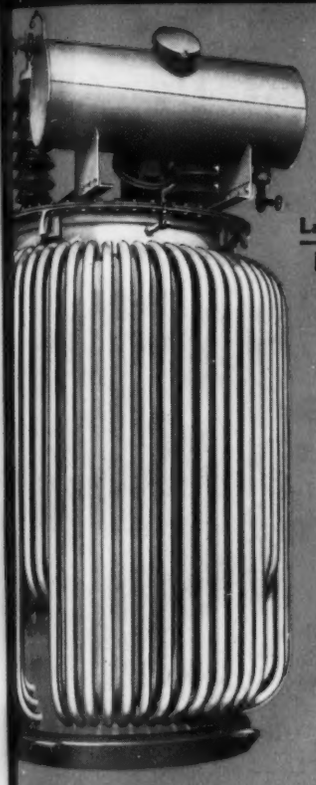
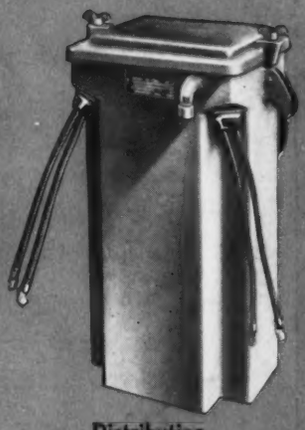


Large Power
$L_o + L_i$



Distribution
$L_o + L_i$

$L_o + L_i$

FEB 16 1932

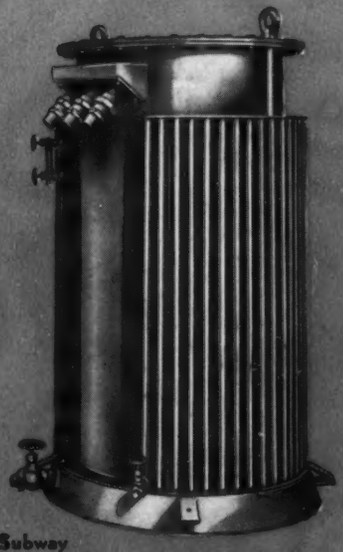
The Common Denominator

WHILE the accompanying photographs indicate that there is a Kuhlman Transformer for practically every kind of service, all these different transformers have the common denominator $L_o + L_i$. L_o is symbolic of the Low Losses, and L_i represents the Long Life that results from the balanced design, excellent materials and painstaking workmanship that are the basis for every type and size of Kuhlman Transformer.

Utilities and industrials have come to recognize $L_o + L_i$ as the outstanding characteristics of all Kuhlman Transformers.

KUHLMAN ELECTRIC COMPANY, Bay City, Michigan
Offices in 32 Cities

Dry Type
$L_o + L_i$



Subway
$L_o + L_i$

Series Multiple Street Lighting
$L_o + L_i$

Branch Line Street Lighting
$L_o + L_i$

Furnace
$L_o + L_i$

KUHLMAN TRANSFORMERS

THE PATH OF LEAST RESISTANCE

Murray Hollow Ground Rods provide the easiest and most economical way of lowering and maintaining ground resistances to desired values. The imbedding of treating solution at or near the permanent moisture level means that solution is where it will give immediate results — where it will last the longest and where it will do the most good.

A low resistance ground path for lightning discharge is good business, for it assists your protective devices to do their full duty.

Treating solution poured or pumped into the copper tubing dissipates into the surrounding soil through the holes in the tubing.

Treating the MURRAY way means that precipitation will not affect the path to ground.

Where on your system have you encountered stubborn high resistance? Why not make a test installation there?

Send for booklet— tell us your problems.

MURRAY
HOLLOW GROUND ROD

METROPOLITAN DEVICE CORPORATION, Brooklyn, N. Y.

Gentlemen:—

Send 8 Page Booklet Describing the Murray Hollow Ground Rod.

Name .....

Position .....

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A consolidation of Electrical World, Electrical Engineer and American Electrician

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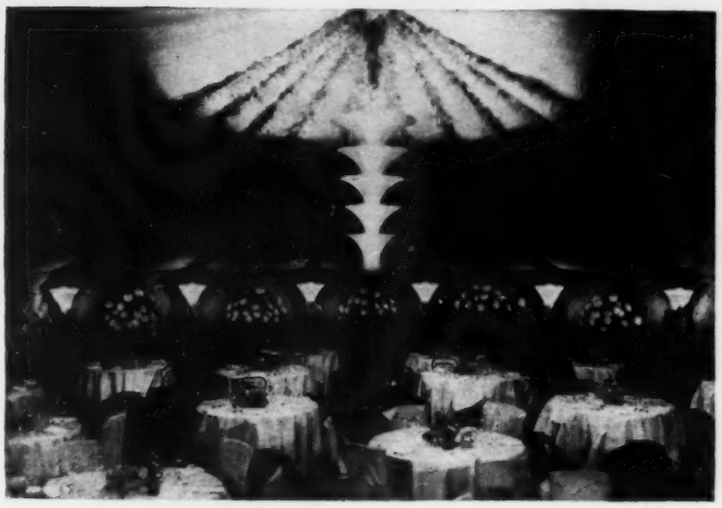

Temporary tent lighting
Cleveland, Ohio

FEBRUARY 13, 1932

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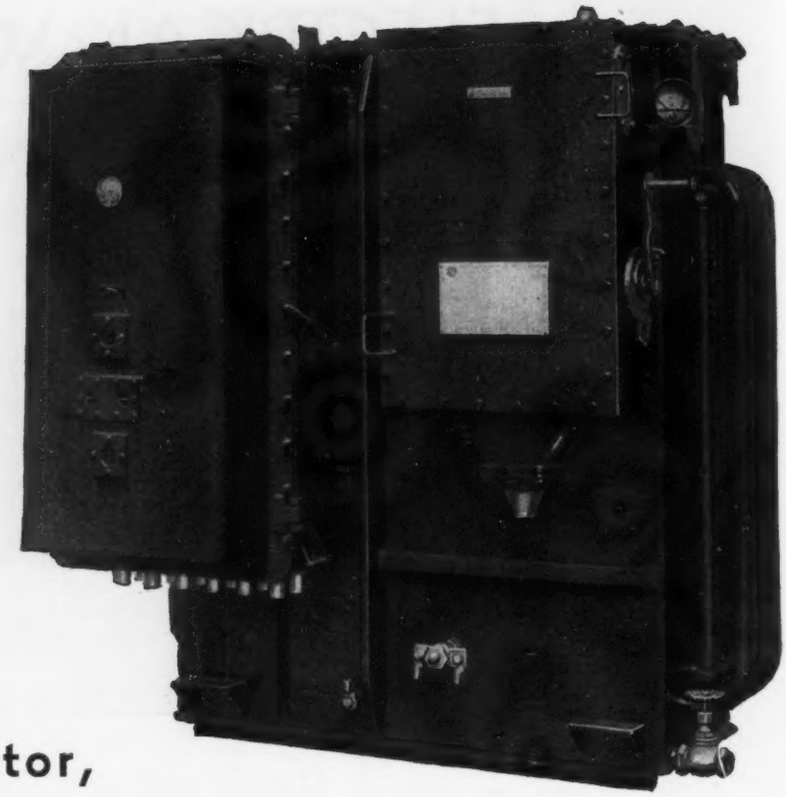
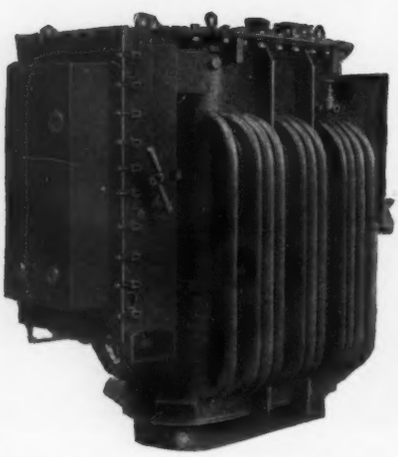
To simplify secondary network installations



Transformer, protector, and disconnecting switch are combined in a 3-phase unit, and arranged to fit the layout of your vault



Bulletin No. GEA-1248 describes the special features embodied in G-E equipment for secondary network systems

The combined unit affords the following advantages over individually mounted equipment:

Simplified installation
Lower installation cost
Reduced space requirements

The low-voltage network protector case, and the high-voltage junction box, which contains a disconnecting and grounding switch, are removable for convenience during installation. The illustrations, of 300-kv-a. subway units, show where these devices are usually mounted on the transformer.

The protector can be arranged to accommodate as many as 12 outgoing secondary cables, thereby reducing the number of cable splices required.

JOIN THE "G-E CIRCLE"—SUNDAYS AT 5:30 P. M., E. S. T. ON N. B. C. NETWORK OF 54 STATIONS—WEEK-DAYS (EXCEPT SATURDAY) AT NOON.

401-28

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

February 13, 1932

It is impossible to think of the legislative bodies in our democracy without considerable cynicism. A proposition goes through, not on its merits, but because the legislators are convinced that there are more persons for it than opposed to it.

JAMES G. HARBORD,
Chairman of the Board
Radio Corporation of America

[General Harbord was one of a group of business men who met in New York last week to organize efforts against large public expenditures.]

—**China developed electrically** nearly 500 per cent in the past decade. More than 700 power plants total about 850,000 kw. in capacity. Steam generation predominates; water-power developments few—*p. 319.*

—**To obtain benefits of mergers** M. S. Sloan points out that standardization and unification must be developed. Upon the basis of such activities potential economies and efficiencies may be fully realized—*p. 323.*

Ontario orders commission inquiry

—**Ontario Hydro is under fire** and Justice W. E. Middleton of the Supreme Court of that province has been appointed a one-man commission to investigate. Not a general inquiry—*p. 294.*

—**Is runner pitting necessary?** Causes of spot oxidation and electrolytic action analyzed and corrective measures adopted. Problem largely one of design to eliminate void formations—*p. 328.*

New electrical market developing?

—**Look out for air conditioning;** it is likely to be the sensation of the year. Manufacturers are offering equipment for the home and office, and the battle for the consumer's dollar will soon be on—*pp. 302, 303.*

—**Pennsylvania R.R. may borrow** from the Reconstruction Finance Corporation to permit continuation of its electrification program. President Atterbury hopes for $5,000,000 a month; a $100,000,000 total—*p. 294.*

Construction costs drop to 1916 level

—**Electric construction costs** return to 1916 levels. Averages at close of 1931 were 22 per cent below beginning of 1930 and 65 per cent below the post-war peak. Still 42 per cent above 1913, though—*p. 318.*

—**Relaying practices analyzed** to show how the present state of the art assures system stability and service continuity when protection is properly planned. Problem reduces to three basic elements and approaches—*p. 310.*

Harold B. Smith passes on

p. 295.

Ontario Government Appoints Commission of One to Investigate Hydro

APPOINTMENT of a royal commission to investigate affairs of the Ontario Hydro-Electric Power Commission has been decided upon by the Ontario government. It will be a one-man commission, Justice W. E. Middleton of the appellate division, Supreme Court of Ontario, having been selected for the task.

In announcing the decision to investigate Hydro matters, Premier George S. Henry pointed out that the government had decided that inquiry into general questions of policy was not warranted. For that reason the scope of the inquiry would be limited to matters pertaining to Hydro which have been subject to persistent criticism, mainly the facts relating to the payment by the Hydro Commission to John Aird, Jr., of Toronto, of the sum of $50,000 in connection with the purchase by the commission of what are known as the Madawaska properties and the purchase by the commission of the property and assets of the Dominion Power & Transmission Company and the price paid therefor, which is alleged to have been several million dollars more than was necessary.

Considerable criticism has been leveled at the government for its appointment of a one-man commission and on the ground that the suggested scope of the inquiry is totally inadequate. Mitchell F. Hepburn, Ontario Liberal leader, said: "The scope of the inquiry should be widened to include contracts made with the Gatineau Power Company and Beauharnois. I want the books of every company doing contract business with the Hydro Commission laid before the royal commission, particularly those of the Abitibi Power & Paper Company." The Beauharnois transactions include acceptance by Mr. Aird of $125,000 from that corporation to secure a long-term contract for the supply of power to Ontario. This amount was declared by Beauharnois officials to be a political contribution to the Conservative party, in power in Ontario as well as at Ottawa, but the allegation was denied by party officials and Mr. Aird.

▼

Crisp County Plant Saved to Community for 1932

Through the efforts of a committee of citizens, which recently raised $18,500 by private subscription, the publicly owned Crisp County power plant on the Flint River, near Cordele, Ga., has been saved to the community for at least another year. The sum raised enabled the officials of the county to forward $25,000 to New York with which to take up outstanding bonds due on February 1, as well as to pay an interest premium of $31,500, due on the same date. These payments, it is stated, make it sure that the plant will remain, at least for the immediate future, in possession of the county.

The unique character of this hydro-electric enterprise as the only county-owned plant in the nation and its recent vicissitudes, with the overtures of sale to the Georgia Power Company, have made it nationally known in electrical circles. (See ELECTRICAL WORLD, January 2, page 7.)

▼

Kehoe and Tapscott Vice-Presidents N. Y. Utility

Formal election of Frank W. Smith, the new president of the New York Edison Company, to the presidency also of the United Electric Light & Power Company was consummated on Tuesday of this week at an organization meeting of the last-named company. Arthur H. Kehoe, electrical engineer of the United company, and Ralph H. Tapscott, electrical engineer New York Edison, were elected vice-presidents. John C. Carroll, who has been assistant secretary of the United, was appointed treasurer, succeeding George M. Moore, who retires after nearly 40 years of service. Melville T. Chandler was reappointed secretary.

New directors of the United Electric Light & Power are Floyd L. Carlisle, Oscar H. Fogg, Eugene H. Rosenquest and Philip Torchio. At a stockholders' meeting of the New York Edison Company new directors elected were Charles E. Mitchell, Philip Torchio and George Whitney, to replace George F. Baker, deceased, and F. W. Jesser and John D. Ryan, who retired.

▼

Pennsylvania R.R. Will Ask Loan for Electrification

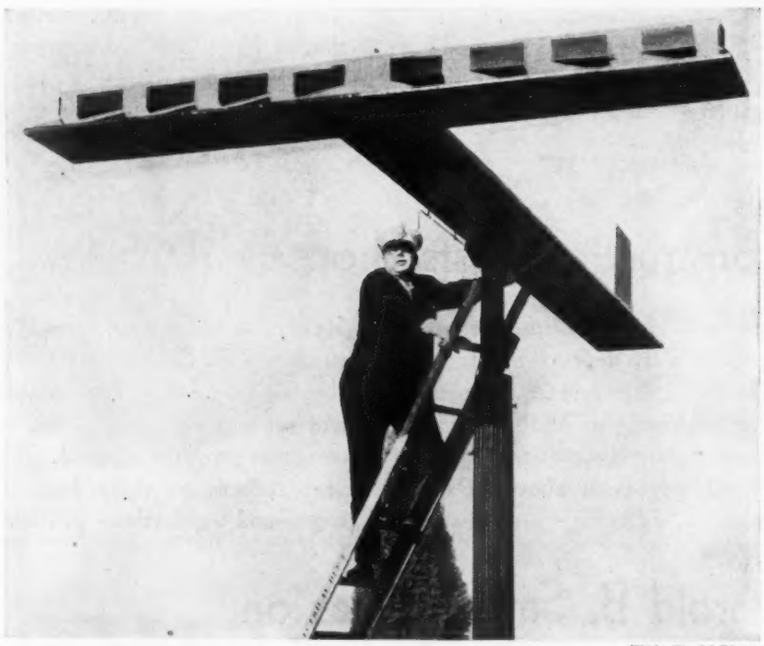
Reconstruction Finance Corporation will be solicited for a large sum monthly to expedite the undertaking

Application will be made by the Pennsylvania Railroad to the new financing agency of the federal government, the Reconstruction Finance Corporation, for monthly loans for an unstated period, it was announced a week ago by W. W. Atterbury, president of the railroad. The loan would be used to continue electrification of the road's main lines, the estimate cost of which will be $100,000,000, and for terminal improvements.

"The time of making the application

▼

NEON-LIGHTED WIND TEE AT CALIFORNIA AIRPORT



—Wide World Photos

Eighteen feet long, this structure is visible for three miles in daylight and farther at night. It veers under the influence of a three-mile-an-hour wind and is proving an aid to safe landing.

or the extent of the loan has not yet been definitely determined," said Mr. Atterbury, "but it will be made for a reasonable sum—a rough sum would be about $5,000,000 a month—considering the large program of electrification and terminal improvements which the company has under way. Every penny requested from the Finance Corporation will be utilized for the purpose of giving employment and ordering materials from various industries. The company will make its own arrangements to meet maturities and similar obligations."

It is estimated that continuance of the electrical project on the original schedule, which was recently slackened because of the difficulty in raising funds, will provide work for 15,000 to 20,000 men. About 10,000 men would be required for work on the electrification, and 5,000 or 10,000 more would be required in the electrical companies and collateral industries.

▼

Indiana Commission Still Aggressive for Lower Rates

Emergency utility rates for Indianapolis, materially reducing the present schedules, are being considered by the Indiana Public Service Commission, and it is said to be probable that such an order will be issued within a month. If it is, the commission will be following the precedent established in the Marion case, where a flat 20 per cent reduction was ordered which, as reported last week (page 253), is now awaiting adjudication in the federal courts, with a temporary injunction against the commission's order in force.

Twenty separate investigations, with the idea of lowering rates, have been launched by the commission against all properties of the Indiana General Service Company except those at Muncie, where a rate case is already pending. The Indiana General Service, an American Gas & Electric Company subsidiary, is the utility proceeded against at Marion, and the contemplated investigations are regarded as a sort of reprisal for the refusal of the company to accept the cut ordered for that city.

▼

Utility Proceedings in Four State Legislatures

A bill enabling third-class cities to acquire, construct or operate electric light, heat and power plants was unanimously passed by the Kentucky House last week. A referendum on the purchase price was required by an amendment made.

The South Carolina power rate investigating committee has recommended elimination of its proposal to include municipal electric plants in the regulatory act now pending before the Legislature, on which hearings are being held.

An investigation into the finances of the New England Power Association and the New England Power Company by a special legislative commission was asked last week from the joint rules committee of the Massachusetts Legislature. F. J. Finneran declared such an inquiry would show great abuses. For the Power Association is was pointed out that the Federal Trade Commission has already made a similar inquiry.

A bill introduced by Assemblyman Brown, majority leader in the New Jersey Assembly, would forbid the State Board of Public Utility Commissioners for two years after the passage of the act to order any railroad or other utility company to make alterations or extensions to its plants. Ostensibly meant to postpone grade-crossing elimination in the interest of state economy, the bill, if passed, which in its present shape is considered unlikely, would deprive the commission for the next 24 months of most of its power.

Credit Deflated Further; Prices Still Recede

DEFLATION of credit continues, accompanied by a further decline in commodity prices. Deposits, loans and investments of Federal Reserve member banks still point downward. Money in circulation is a billion over the figure of a year ago, suggesting continued hoarding. Bankers regard the present total as excessive.

The automobile industry is apparently failing to maintain its seasonal improvement. General Motors' January sales are off 10 per cent from December. But the Commerce Department reports a large drop in cars in dealers' hands throughout the world.

The recession of 75,000 tons in U. S. Steel unfilled tonnage is attributed to hand-to-mouth buying and reduced activity in railroad work and building.

Bank failures continue to impair confidence. Last week 71 suspensions were reported. Weekly average this year to date is 72.

World conditions continue definitely unfavorable looking to the near future.

▼

Harold B. Smith Dies at Worcester

DR. HAROLD S. SMITH, for 35 years and until two years ago head of the department of electrical engineering at the Worcester (Mass.) Polytechnic Institute, who was also president of the American Institute of Electrical Engineers in the year 1929-30, died in Worcester on Tuesday, February 9. Dr. Smith, who had been in poor health for nearly two years, would have been 63 next May. Before his connection with the Worcester Polytechnic Institute he had held professorships at the University of Arkansas and at Purdue. He was born in Barre, Mass.

Dr. Smith's death brought forth warm tributes from leading electrical technicians and educators. Early closing necessitated by the Lincoln's Birthday holiday compels the ELECTRICAL WORLD to withhold a more extended notice until next week.

▼

Surge Generator Energy Is 36,000 Watt-Seconds

With an output so great and of such characteristics that service conditions may be duplicated in the largest transformers now built or—it is thought by Westinghouse engineers—likely to be built in the near future, the new 3,000-kv. surge generator at the Sharon (Pa.) works of that organization offers an important new test element. The equipment is said to deliver more than twice the energy derivable from any other impulse generator in the world.

An energy output of 36,000 watt-seconds at 3,000 kv. is produced. The capacity is 0.0080 microfarad. The unit consists of 30 groups of four condensers in series. After the groups are charged in parallel and the first gap breaks down, they discharge in series to produce the energy charge.

▼

Conciliatory Spirit in Oregon Merchandising

Sympathetic consideration of the grievances of furniture, department and hardware store retailers of electrical and gas appliances arising from competition with utility companies in these lines characterized the first hearing on a two-year-old complaint before the Oregon Public Service Commissioner on January 21, when the Oregon Merchants' Utility Bureau represented a number of such retailers. The complaint alleged that the accounting practices of the utility companies did not show the true results of the utility merchandising operations.

Nearly all the utility companies in the state were represented, and, while it was made plain that the Oregon Public Service Commissioner could take jurisdiction only over the accounting phases of the problem, there was virtually no effort made by the utilities to

exclude testimony bearing on alleged unethical practices in the past. All the companies expressed a willingness to keep their merchandising accounts in any manner that might be suggested by the commissioner.

▼

Further Inquiry Into National Electric Power

Aaron J. Hughes, investigating accountant for the Federal Trade Commission, again took the stand on February 3 when the commission picked up the thread of its inquiry into the National Electric Power Company. He testified in great detail along the same lines as before concerning book values and so-called "write-ups." Only a few of the matters canvassed can be referred to here.

The National Electric Power Company, Mr. Hughes said, carried on its own books the properties of its subsidiaries at $3,487,442 in excess of the value at which they were carried on books of the subsidiaries. This excess amount was based on the appraised value of the subsidiaries' property. Mr. Hughes stated that the original amount of this excess appraisal was $9,311,195, which was at the end of 1925, the year in which National was organized. As individual companies were disposed of or as the subsidiaries took up the appraised figures in their accounts, however, the amounts entered in the accounts of National for the excess appraisals were canceled by reductions in the asset and capital surplus accounts.

Summarizing the company's financial operations from its organization in 1925 to September 30, 1930, the examiner showed that the main source of income was received from dividends on common stocks of subsidiaries and that these aggregated $11,211,297, or approximately 64 per cent of the total income and surplus additions.

The examiner said that earnings of the National Electric Power Company alone from 1926 to September 30, 1930, showed a rate of return averaging 8.49 per cent on the investment, including appreciations, and 9.88 per cent, excluding appreciations. The highest rate of return, including appreciation, was in 1928 and was 13 per cent. Rate of return on the common stock equity, including appreciations, was highest in 1928, when it amounted to 20 per cent. Its average in the period was 10.9.

On the following day the National Public Service Corporation, a subsidiary, was examined into, and its return on average investment in common stock, figuring investment on book cost and before deduction of federal income taxes, was said to have been 16.4 per cent.

Still further testimony was recorded on Friday before the hearings were adjourned to February 16. Mr. Hughes said that the National Public Service Company and its subsidiary holding company, the Municipal Service Company, recorded profits totaling $2,740,904 as a result of appreciation of securities transferred to and from subsidiaries. Profits, for instance, were recorded from the transfer of common and preferred stocks of the Alexandria Light & Power Corporation of $563,010 by Municipal when it sold these stocks to National in exchange for stock of the Eastern Shore Gas & Electric Company, the Alexandria stocks being transferred by National to Virginia Public Service for merger. Again, National recorded a profit of $515,650 in September, 1926, through the transfer of the preferred and common stock of the Florida Power Corporation to the Tide Water Power Corporation. The last-named utility will be the next subsidiary to be taken up by the investigators.

▼

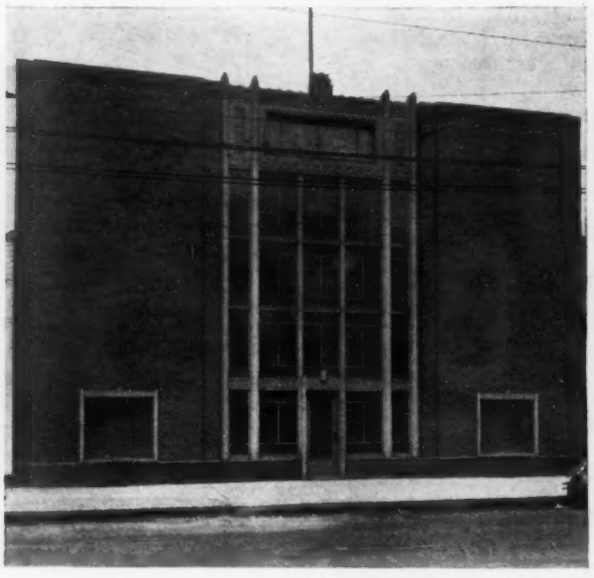
Must Not Tax Customers for Excessive Investments

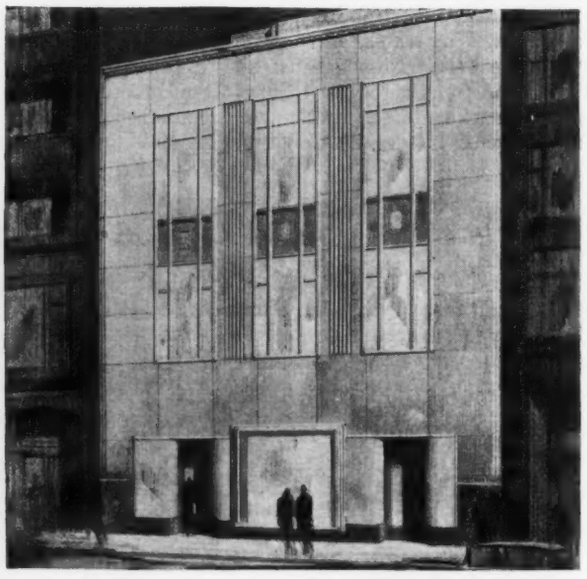
In reducing rates for energy furnished to the city of Troy, Ala., by the Alabama Utilities Company for resale to citizens, the Alabama Public Service Commission said:

Upon the basis of the testimony of defendant's own engineer, it is clear that the ratio of investment claimed to gross revenue is abnormally high, which tends to show that the investment is excessive and imprudent, or that the project was ill conceived, since *prima facie* its rate structure generally is reasonable, and there is nothing here to show that its rates are too low, when due consideration is given to the reasonable value of its service to its customers. If the defendant's investment is excessive or imprudent, or the project was ill conceived, it does not follow that such mistakes may be laid as a burden upon the public in the form of excessive or unreasonable rates.

▼

Commonwealth Edison Company Will Have Novel Substations





An unattended automatic substation open to the public gaze, with an illuminated sign inside explaining the functions of the various equipment to passers-by, is under construction by the Commonwealth Edison Company on Kedzie Avenue (left). The glass façade will allow inspection from the street.

At the right is the Garland Court substation in the "Loop" area, also in construction. This structure is planned to permit the rental of the entire first floor and the front portions of the second and third floors for the ordinary commercial purposes of downtown buildings.

Modern Sales Policy Is Expounded to Oregonians

A business development program significant of the trend of the times was outlined at the annual sales meeting of the Pacific Power & Light Company, Portland, Ore., recently held, by V. H. Moon, the company's sales manager. Mr. Moon said that if the business development program of a utility company benefits alike the utility, the manufacturers, wholesalers and dealers and the public, then it is economically sound. The program he put forth emphasized kilowatt-hours to be sold rather than units of electrical merchandise, called the salesmen "territorial representatives" rather than "salesmen," gave them assignments in numbers of specific utilization devices to be added to the lines in their particular territories by dealer and company sales combined, rather than dollar-and-cent sales quotas as in the past, and provided for compensation of the territorial representatives on the basis of load added by dealers and company rather than on their own sales solely.

▼

Chicago Adds 250 Miles of Residence-Street Lighting

Chicago has just completed the installation of 250 lineal miles of residential street lighting which has increased illumination from 4,200 to 12,500 lumens per block. Designed for scattered sections of the city which had inadequate lighting or none whatever, the project embraced an enormous amount of equipment. Eight thousand cast-iron standards with fittings were manufactured at the Cleveland plant of the Westinghouse Electric & Manufacturing Company. In addition, 2,500,000 ft. of duct line, 400 transformers for 180 manholes, 225,000 ft. of 2-in. pipe laterals, 3,000,000 ft. of single-conductor and 100,000 ft. of four-, eight- and twelve-conductor cables were used in installing the system.

The lamp posts are 11 ft. high, mounted on separate concrete foundations and equipped at the top with series receptacles and sockets housed in ornamental glass and post-top lamp fixtures. These posts are spaced five to the standard 660-ft. block, two being placed at each street intersection on diagonal corners and the others in staggered relation, providing a lamp at each intersection of street and alley.

Electrical energy is obtained from the Sanitary District of Chicago. This energy is brought into the various municipal substations from which the lighting system is fed by circuits of 5,050-volt, single-phase, 60-cycle alternating current of a constant value of 6.6 to 10 amp. This energy is conveyed over multi-conductor lead-covered cables occupying underground conduit lines to the points of connection with the primary 5,000-volt armored cables.

▼

California Commission on Its "Major Contribution"

Frank applause for its own regulatory accompblishments is contained in a letter from the California Railroad Commission to Governor Rolph accompanying its annual report. Says the commission:

It can be said that the major contribution that regulation has made occurred not during the period of depression but during years of "good times." During those years when overcapitalization ran rampant regulation saved the utilities from themselves. Such increases in capital stock or in bonds as were made were based upon an increase in actual assets rather than upon a hysteria of optimism. Stock dividends to distribute surplus created by a revaluation of assets have not been allowed. Nor were surplus funds spent in overenthusiastic expansion activities engendered in hope rather than fostered by prudent business foresight.

That this is true utility chieftains frankly admit. Its truth is again shown in the fate that has befallen some of the holding companies whose national operations have not rendered them subject to state regulation. While utility securities have naturally reflected the depressed market for stocks and bonds, yet the fact is also true that regulation has had a supporting effect upon their value.

▼

Iowa Men Explore New Markets for Lighting

Two hundred attended the annual two-day session of the sales and distribution school of the Iowa Division of the National Electric Light Association in Sioux City recently, at which Mark Hapster of Mason City was selected as chairman to succeed V. O. Stafford.

Joe Carmichael, director of the Iowa Committee on Public Utility Information, told of the trend away from municipal ownership of electric light and power plants in Iowa (ELECTRICAL WORLD, December 26, 1931, page 1115). That the future growth of electrical service must come from increased sales to existing customers was the view of W. H. Rademacher, Edison Lamp Works, Chicago, who maintained that the market for floodlighting and decorative lighting is only in its initial stage. Dual-purpose lighting and sun lamps in the home, he said, also loom as large new fields. Paul C. Porter, Iowa Southern Utilities Company, said that his company had added 550 farm customers in the past fifteen months. A score of other experts addressed the meeting.

Coming Meetings

National Electric Light Association—Group committee meetings: Accounting National Section, Statler Hotel, St. Louis, Feb. 15-17; Commercial National Section, Edgewater Beach Hotel, Chicago, March 22-24. A. J. Marshall, 420 Lexington Ave., New York.

Great Lakes Division, N.E.L.A.—Sales conference and Commercial Section, Edgewater Beach Hotel, Chicago, Feb. 18 and 19; Engineering Section, Sherman Hotel, Chicago, April 13 and 14. R. J. Malcomson, 72 W. Adams St., Chicago.

Northwest Electric Light and Power Association — Commercial Section, Multnomah Hotel, Portland, Ore., Feb. 18-20; Berkeley Snow, 1206 Spalding Building, Portland. Engineering Section, Heathman Hotel, Portland, April 13-15; H. H. Schoolfield, Pacific Power & Light Company, Portland. Accounting Section, Davenport Hotel, Spokane, Wash., April 18-19; W. F. Miller, Washington Water Power Company, Spokane.

National Association of Purchasing Agents—Public Utility Group, Birmingham, Ala., Feb. 18-20. G. A. Renard, 11 Park Place, New York.

North Central Electric Association—Engineering Section, St. Paul Hotel, St. Paul, Feb. 22 and 23. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Oklahoma Utilities Association—Tulsa, Okla., March 8 and 9. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

American Institute of Electrical Engineers—District meeting, Milwaukee, March 14-16. F. L. Hutchinson, 33 West 39th St., New York.

Maryland Utilities Association — Lord Baltimore Hotel, Baltimore, April 8. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

New England Division, N.E.L.A.—Safety conference, Boston, April 8. Miss O. A. Bursiel, 20 Providence St., Boston.

Arizona Utilities Association—Tucson, Ariz., April 13-15. J. S. Arnold, Central Arizona Light & Power Co., Phoenix, Ariz.

Southeastern Division, N.E.L.A. — Old Point Comfort, Va., April 20-22. C. M. Kilian, 508 Haas-Howell Bldg., Atlanta.

Electrochemical Society—Lord Baltimore Hotel, Baltimore, April 20-23. C. G. Fink, Columbia University, New York.

Southwestern Division, N.E.L.A. — Arlington Hotel, Hot Springs, Ark., April 25-28. S. J. Ballinger, San Antonio Public Service Co., San Antonio.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 28-30. F. D. Beardslee, 315 N. 12th St., St. Louis.

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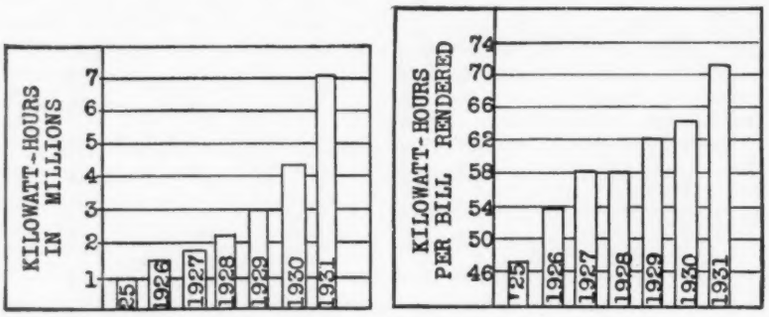
Oil-Engine Power Costs Gathered by A.S.M.E.

Ninety-four plants containing 283 oil engines are listed in the initial report of a subcommittee of the American Society of Mechanical Engineers appointed to gather data on the power costs of such engines, including also information on such points as economy in fuel and lubrication, purification of lubricating oil, handling cooling water, liner wear and taking care of peak loads. The interest in the subject is said to be growing rapidly, but the full value of the investigations will not be developed for some years. Eventually the data are expected to show the length of the repair-cost cycle, the useful life of engines, the proper attendance ratio, the proper rating for various types of engines and so forth.

Rural Service Increases Sevenfold in Six Years

During 1931 the kilowatt-hour consumption of farms served by the Public Service Company of Northern Illinois increased 60 per cent and the number of customers increased 44 per cent. In 1925 the kilowatt-hour consumption of farms served by the company was less than 1,000,000 kw.-hr. In 1931 it was 7,000,000. A few more than 100 farmers connected during each month of 1931, or a total of 1,226 new customers, now making a total of 8,048 farms served with electricity, which represents 34 per cent of the farms in the territory.



Sevenfold rural-service increase is reported in northern Illinois since 1925

One of the outstanding rural developments in the past year is that of the use made of lead-covered cable in hotbeds and bench heating in greenhouses and on vegetable-truck-growing farms. In the spring of 1931 fourteen farmers in the territory used this cable in the growing of plants for transplanting purposes, and since then several greenhouses have installed it to aid shrubs and other plants in developing strong roots. More than 2,000 ft. of this cable has now been installed, and with the increasing use being made of it by the greenhouses, it is hoped that at least 8,000 ft. will be sold in 1932.

▼

Ross Wants $3,000,000 for Diablo Construction

J. D. Ross, Seattle Superintendent of City Light, has announced that he will ask the City Council to authorize soon an offering of $3,000,000 in revenue bonds, the proceeds to be used to pay for machinery, cable and contracts on the Diablo projects and to string a double transmission line from the Diablo power house to the line at Gorge, which runs to Seattle. "Some say you cannot sell bonds now," Mr. Ross said. "You can't if you don't try. I mean to try." Mr. Ross points out that outstanding obligations total $1,314,751. With $1,506,415 to complete the Diablo power house and $64,774 to connect with the Gorge transmission line, the sum required at this time, according to the Superintendent of City Light, is $2,885,940.

"When Diablo is operating it will produce the full 180,000 hp. for about nine months of the year," Mr. Ross went on, "and will more than double the present Skagit capacity over any low period. The saving in fuel oil alone would more than offset carrying charges on $3,000,000 in bonds."

The Diablo unit of the Skagit River power development, including the dam, tunnel and power house, will represent an investment of $10,290,004, of which $7,404,334 has been expended.

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Beauharnois Reorganization; American Scheme Denied

Terms and conditions of the new order-in-council under which the Beauharnois power project is to receive approval are now engaging the Canadian government. The questions involved are the reorganization of the company's board and the terms upon which the power rights shall be granted. The banks are continuing to finance the project, although upon a restricted scale, pending definite approval of the reorganization. Three prominent directors—W. L. McDougald, R. O. Sweezey and R. C. A. Henry—and the secretary-treasurer, Hugh B. Griffith, have resigned.

Addressing the annual convention of the Ontario Municipal Electric Association in Toronto on January 27, C. A. Maguire, Ontario Hydro Commissioner, sprang something of a sensation when he declared that while the Beauharnois investigation was in progress at Ottawa last year "United States power interests" staged a private luncheon in a Toronto hotel and made overtures to himself and Mayor Stewart of Toronto for the purpose of securing their aid so that the United States interests could acquire the Beauharnois development. Mr. Maguire said he had refused to be a party to any such scheme. It did not appear that any one from the United States was present at the luncheon, and Mr. Maguire's statement that Dr. A. T. Shillington of Ottawa represented himself as a spokesman for the Doherty company met with a flat contradiction from that gentleman and a prompt denial from Doherty executives in New York that any representative of theirs was concerned.

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International Electrical Congress to Open July 4

Best available information is to the effect that the International Electrical Congress to be held at Paris in the coming summer will open on Monday, July 4, and close on July 12. Reservations have been made tentatively for American delegates on the Cunard Line steamship *Franconia*, sailing from New York on June 24 and arriving at Havre on July 2. Inquiries by those desiring to attend should be made at the earliest possible date to Thomas Cook & Son.

▼

Secretary Hyde Opposes Columbia River Project

Opposition to the proposed four-hundred-million-dollar Columbia Basin irrigation project to bring 1,200,000 acres of land in the Pacific Northwest into agricultural production, with incidental development of more than 1,000,000 primary and as much more secondary horsepower, was expressed last week by Secretary of Agriculture Hyde, in a statement submitted to the board of engineers for rivers and harbors, Department of War. Mr. Hyde declared the project to be far beyond the needs of the region concerned, thus differing with Dr. Elwood Mead, Commissioner of Irrigation, who, as reported in the ELECTRICAL WORLD for January 30 (page 209), is optimistic concerning ultimate success for the scheme.

Secretary Hyde's statement was presented at a public hearing held by the board of engineers. Governor Meier of Oregon, A. E. Clark of the Oregon Hydro-Electric Commission and several members of the upper or lower congressional chamber appeared in support of the undertaking.

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Utility Figures Rejected for Los Angeles Lines

Valuation by the California Railroad Commission of the distribution system of the Southern California Edison Company in certain portions of the city of Los Angeles for purposes of condemnation by the city has been finished, and the commission announces that the sum

of $1,390,000 has been fixed as the compensation that the city is to pay for such properties in Hamilton, Santa Monica Canyon, Venice, Green Meadows, Buckley, Watts, Sunland, Martel and Beverly Glen, all within the city limits. Of this amount $1,265,000 is for valuation of the property and $125,000 for severance charges. As against the figure of $1,390,000, the valuation figure of the city was $1,385,000 and that of the company ran from approximately $4,800,000 to $6,200,000, both including severance charges.

A second decision established the value of the property of the Southern California Edison in the Tuna Canyon, Mar Vista and Barnes City additions. The value fixed on this property by the commission is $379,000, as against a valuation of $351,700 fixed by the city. The estimates of the company varied from approximately $600,000 to $900,000, all figures including severance charges. The commission's decision was unanimous.

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Hulswit Men Resign from North Canada Subsidiary

Resignation of three officials of the American Commonwealths Power Corporation from the board of the Dominion Gas & Electric Company, a Canadian utility group which it controls, has occurred. Those resigning were Frank T. Hulswit, president of American Commonwealths Power; David A. Belden, vice-president, and Albert Vermeer, secretary. These vacancies and another that has existed for some time will be filled by H. W. Briggs, Herbert L. Nichols, Ralph P. Buell and E. A. Harden. Mr. Briggs and Mr. Nichols are two of the receivers for American Commonwealths Power, but the Canadian subsidiary is said not to be directly affected by the receivership.

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Ohio Companies Plan $20,000,000 Merger

The process of defining spheres of service as between utility system and consolidating state groups continues in the Ohio Electric Power Company's action to merge fourteen companies into a $20,000,000 corporation. An application with this object has been filed with the Public Service Commission. The company also seeks to issue about $12,000,000 of securities to finance the merger. This would include $11,000,000 worth of 6 per cent 30-year bonds and 56,800 shares of no-par preferred stocks to market at $90 per share.

Companies involved in the merger proposal include the Columbus, Delaware & Marion Electric Power Company, Mount Gilead Water, Light & Heat Company, Morrow Public Service Company, New London Power Company, General Utilities Company, Ohio Northern Public Service Company, City Water Company, Buckeye Public Service Company, Asheville Light & Power Company, West Jefferson Power & Light Company, Central Utilities Company, Reserve Power & Light Company and the Western Reserve Power & Light Company.

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Common Stocks Are Passing to Smaller Investors

COMMON stocks of the nation's industries have been passing into the hands of smaller holders at an accelerating rate during the past two or three years. Taking industry as a whole, it is probable that the number of stockholders has increased at least 40 per cent in the last two years. Seven of the largest corporations show a 70 per cent rise in three years and the movement is apparently more rapid in the last few months.

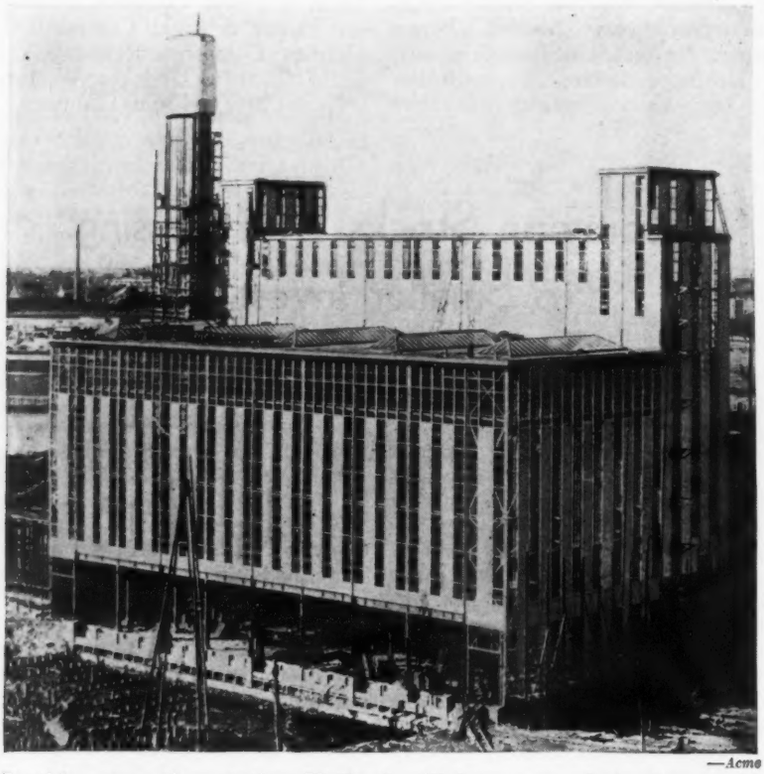
In addition to surveys that have been made by corporations anxious to learn where their equity lies, evidence of the existence of such a trend is presented by brokerage houses. Brokers engaged in the odd-lot business state that there has been remarkable expansion in stockholders' lists. Transfer agents record an unusual increase in the number of new accounts at the beginning of the current year and small buyers are stated to be diversifying their lists more carefully than ever before, and they are, of course, paying cash.

Whether or not the utility industry would show a 40 per cent rise in the number of stockholders in the past two years is problematical. American Telephone & Telegraph Company increased its shareholders from 454,596 at the end of 1928 to 644,903 as of December, 1931, it is understood—a 42 per cent rise. Stockholders of the North American Company numbered 42,000 at the end of 1928 and about 64,000 at the end of 1931, a 52 per cent rise in three years. Back in 1924 the North American Company had about 11,550 common-stock holders. At present the total is 54,000, and there are more than 9,500 preferred-stock holders. The total increased 22 per cent last year, 21 per cent in 1930 and 15 per cent in 1929. Of course, if preferred stock is included in the totals, several of the power and light companies have increased their lists very rapidly by sale to customers.

From the standpoint purely of prices, the rate of purchase by small investors is, of course, greatly facilitated by the fact that they can now acquire stocks at a fraction of their bull market price. The other factors are that, despite lower income, reduced living costs make it possible to set aside more of a surplus for investment than formerly and the tendency to spend less freely also expands the margin available.

After moving horizontally for several weeks, utility common stocks dipped to a new low for the bear market. Disappointing January business is reflected even in utility stock prices, although kilowatt-hour output is well maintained.

POWER STATION NEARS COMPLETION AT ROTTERDAM



—*Acme*

In this generating station Holland will have one of the largest in Europe. Two 42,000-kw. turbo-generators of Metropolitan-Vickers make are being installed. The turbines are two-cylinder type, 1,500 r.p.m., 365 lb. pressure, 752 deg. F. superheat; alternators are three-phase, 5,500/5,800 volts.

▼

Nearly 700,000 Hp. Increase in Water Power

Waterwheels in water-power plants in the United States had an aggregate capacity of 15,562,805 hp. on January 1, 1932, and increased by 681,000 hp. during 1931, according to the annual report just made public by the United States Geological Survey.

The complete report shows the total capacity of waterwheels in plants of 100 hp. or more by states and main divisions of the United States, segregated between public-utility companies and manufacturing companies, the trend in development in different sections of the country and the rank of the ten leading states in developed water power from 1921 to 1932. There was an increase of 25,000 hp. or more during 1931 in each of the states of Maine, Pennsylvania, Georgia, Missouri, Arkansas, Washington and California.

Attention is called to the rapid increase during the past decade. In the later part of 1921 the aggregate rating of water-power plants was 7,927,000 hp. In the ten years since 1921 the capacity has practically doubled and the increase has averaged about 760,000 hp. a year. This average growth is noteworthy, because during this same period the development and improvement of steam power-plant equipment and the increase in the efficiency of operation of steam plants have been almost phenomenal.

Copies of the complete report may be obtained upon application to the United States Geological Survey.

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Progress of Electricity in Japan Continues

Japan had 6,683 plants in operation for supplying electrical energy for power and traction purposes at the end of 1929, an increase of 191 during the preceding twelve months, according to a report recently issued by the Japanese Ministry of Communications. The total capacity of the plants in operation was 4,193,623 kw., the respective totals for hydro-electric, steam and other stations being shown in the subjoined table.

Japanese Electric Power Plant Capacity at End of 1929

Plants:	In Operation, Kw.	Under Construction, Kw.	Total Kw.	Increase Over 1929, Kw.
Hydro-electric	2,581,949	1,325,788	3,907,737	— 75,884
Steam-operated	1,540,044	243,981	1,784,025	+164,738
Gas and other internal-combustion-engine-operated	71,630	2,766	74,396	+ 15,098
Totals	4,193,623	1,572,535	5,766,158	+103,952

The aggregate output of energy in Japan in 1929 is given as 11,977,366,000 kw.-hr., of which 10,330,713,000 kw.-hr. was supplied by the hydro-electric plants, 1,632,088,000 kw.-hr. by the steam-operated stations and 14,565,000 kw.-hr. by those operated by gas and other internal-combustion engines.

▼

Canada's Output Off 7 per Cent

Canadian output of electrical energy, like that of companies south of the international line, continues to lag behind the production a year ago, and in rather larger ratio than in the United States. The approach to 1930 production was considerably closer in December than in mid-summer, the decrease in December being 7.1 per cent, against 12.2 in July.

Monthly output statistics for the past two years are shown in the accompanying table, taken from a recent report of the Dominion Bureau of Statistics.

The showing made by the Province of Quebec, which produces more than half of the Dominion's total output, was comparatively good; the December production in 1931 was only 2.9 per cent less than in 1930. Ontario, on the other hand, fell off 21.7 per cent. These two provinces together account for nearly 80 per cent of the total.

A remarkable rise is reported by the Maritime Provinces with a December increase of 25 per cent. The growth in that part of the country has been extraordinary, the output at present being more than three times as great as it was two years ago.

Month	Output, Millions of Kw.-Hr., 1931	1930	Change, Per Cent
January	1,489	1,555	—4.3
February	1,339	1,398	—4.2
March	1,418	1,515	—6.5
April	1,411	1,502	—6.1
May	1,366	1,545	—11.5
June	1,290	1,435	—10.1
July	1,251	1,426	—12.2
August	1,256	1,412	—11.0
September	1,288	1,443	—10.7
October	1,428	1,575	—9.3
November	1,415	1,515	—6.6
December	1,432	1,542	—7.1

▼

Hydro-Electric Progress in Switzerland

According to a report lately issued by the Swiss State Water Power Department, the hydro-electric power stations now in operation in Switzerland have an aggregate capacity of no less than 2,530,000 hp., as compared with only 1,080,000 hp. ten years ago. It is esti-

mated that except for the utilization of water power the country would need to import annually 3,500,000 tons of coal.

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No Merger in Jersey, Asserts Harry Reid

It has been repeatedly rumored, although officially denied, that plans were being made to transfer the Jersey Central Power & Light Company to the Public Service Electric & Gas system, now or later. The Public Service Corporation of New Jersey serves most of the state, and it has been considered a logical idea that the transfer of the Insull property to the Public Service system might eventually be made inasmuch as such a transfer would eliminate duplication of effort and of facilities. Harry Reid, president of the National Electric Power Company, has, however, categorically denied the rumor and stated that all of the common stock of the Jersey Central is pledged as collateral for the twenty-million-dollar issue of National Public Service 5 per cent bonds. The rumor was denied also by Samuel Insull.

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1.63 Mills per Kilowatt-Hour Hartford Mercury Bogey

With the retubing of its mercury boiler soon to be completed, the Hartford Electric Light Company estimates that the operating cost of this section of its generating plant will be 1.63 mills per kilowatt-hour in 1932. In his annual report on 1931 operations President Samuel Ferguson states that by a curious coincidence this is the exact figure at which the Secretary of the Interior has contracted for the sale of Boulder Dam power at its switchboard. This indicates the possibilities of a future lowering of costs when a larger percentage of the company's total power can be so generated.

The total transactions of the Connecticut Valley Power Exchange for the year exceeded 450,000,000 kw.-hr. and resulted in a gross fuel saving by the participating companies of more than $500,000.

Steady development of the company's domestic business, despite curtailed industrial activities cutting revenue by $88,000, enabled the company to carry about $15,000 more to surplus in 1931 than the year before. The average price received for household electricity was 4.9 cents. For many years the company's policy has been to develop in all lines the greatest possible volume of business at a very low margin of profit on each kilowatt-hour sold. Total sales fell off about $306,000 during the year, the gross earnings being $7,257,588. Strict economies were observed without reducing the number of employees due to lack of work. President Ferguson states that if business conditions should continue in 1932 as last year, the operating economies anticipated will insure as good or better performance. It is not apprehended that it will be necessary to curtail personnel for lack of work during 1932. Taxation is becoming a serious question, and it is expected that this year each dollar paid by customers will represent 12 cents of tax and only 88 cents' worth of electric service. Last year 10 cents per revenue dollar went into taxes. A strong plea for stockholder pressure on governmental authorities to cease present excessive expenditures is included in the report.

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Ten Utilities Show Gain in 1931 Net Revenue

Net revenue of the first ten large power and light companies to report 1931 earnings was fractionally higher than 1930 totals. This rather remarkable showing was made, in spite of a 3 per cent loss in gross revenue, largely by a rigid control of costs. The group is widely distributed geographically and accounts for about one-fifth of the industry, hence may be regarded as representative.

Five holding companies included in the group registered a 3.5 per cent decline in gross earnings, but made a fractional gain in net after costs, taxes and depreciation provision. The five operating companies reported a decline of 2.8 per cent in gross revenue and a fractional gain in net. While statistics are not yet complete for electric revenues alone, it is indicated that the decline in gross revenue from electric sources is less than 3 per cent. It is also significant that several substantial rate reductions were made during the past year. Gross revenue of the ten companies follows:

	1931	1930
Holding Companies		
Commonwealth & Southern	$130,116,633	$141,656,530
Engineers Public Service	51,201,540	53,041,640
Pacific Lighting	47,953,017	48,837,557
United Gas Improvement	37,914,976	36,204,054
Montreal Consolidated	25,410,776	23,484,080
	$292,596,942	$302,223,861
Operating Companies		
Philadelphia Electric	$66,318,437	$65,792,117
Detroit Edison	49,232,500	53,706,925
Kansas City Power & Light	14,759,480	14,883,811
Hartford Electric	7,257,588	7,563,008
Pennsylvania Water & Power	5,064,070	4,835,557
	$142,632,075	$146,731,418

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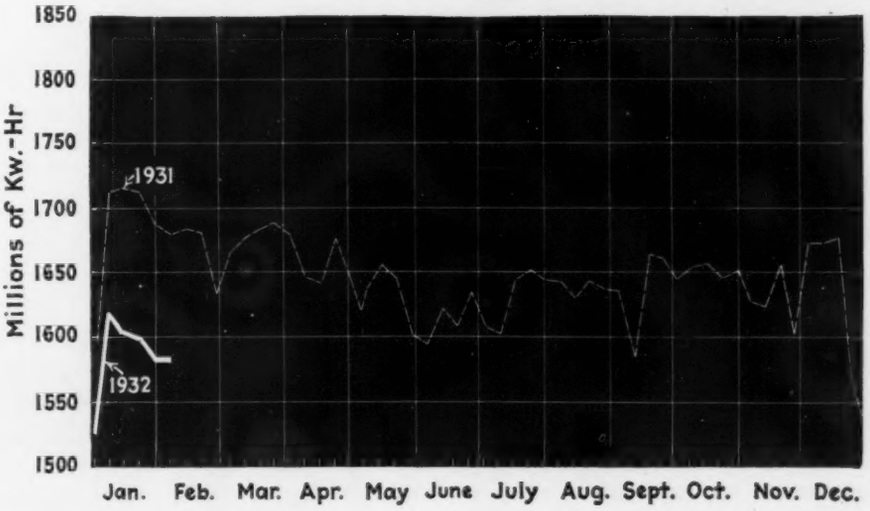
Output Resists Downward Trend



WITH the output during last week maintained at the same level as in the week ended January 30, energy production of electric light and power companies reflected a slight relative gain compared with 1931. Four weeks ago it was down 6.7 per cent compared with last year. This was followed by 6.7, 5.8 and now 5.4 per cent.

Improvement appeared in each region listed, according to weekly surveys by the National Electric Light Association.

Weekly Output, Millions of Kw.-Hr.

	1932	1931	1930	1929
February 6	1,589	1,679	1,782	1,726
January 30	1,589	1,687	1,809	1,728
January 23	1,598	1,713	1,826	1,717
January 16	1,602	1,717	1,834	1,737
January 9	1,619	1,714	1,816	1,734
January 2	1,524	1,597	1,680	1,542

Per Cent Change from 1931

	Week Ended		
Region	Feb. 6	Jan. 30	Jan. 23
Atlantic seaboard	—1.1	—1.9	—2.6
New England alone	—2.3	—2.6	—2.5
Central industrial	—7.8	—8.7	—9.3
Chicago district	—3.5	—5.5	—8.5
Pacific coast	—5.5	—6.5	—7.3

U.S.G.S. Reports 1931 Output Down 4 per Cent

As was indicated by the weekly announcements by the National Electric Light Association, based on telegraphic reports from the larger operating companies, the December energy output for electric light and power in 1931 was somewhat less than in 1930. Results of the more comprehensive monthly compilation by the U. S. Geological Survey, just published, agree closely with those foreshadowed by the weekly figures. The Survey statistics include other utilities in addition to light and power, but the percentage change is virtually the same.

December output was 7,791,259,000 kw.-hr., or 4 per cent under that in the preceding year. Minor revisions when missing returns are included will not materially change the result. Compared with the output in November, 7,405,391,000 kw.-hr., there was an increase of 5 per cent—about the same as in 1930. Of the total, 5,088,007,000 kw.-hr. was generated from fuels, and 2,703,252,000 from water power; that is, 65 and 35 per cent respectively. The average daily production in December, 251,300,000 kw.-hr., was about 2 per cent larger than in November, but the average daily output from water power was about 24 per cent larger. The increase is ascribed to greater stream flow resulting from improvement in precipitation conditions.

Total production for public use in the United States during 1931 was 91,678,000,000 kw.-hr., 4.4 per cent less than in 1930, which in turn was 1.5 per cent less than in 1929. Production from water power was 30,560,000,000 kw.-hr., or 33 per cent of the yearly total and 7 per cent less than in 1930. It was 4.6 per cent less in 1930 than in 1929.

Regional changes, in per cent, compared with total output in the corresponding months of the preceding year were as follows:

Region	November	December
New England	—5	—7
Middle Atlantic	—2	—3
East North Central	—6	—6
West North Central	0	+5
South Atlantic	+2	—3
East South Central	—11	+2
West South Central	—1	—8
Mountain	—13	—14
Pacific	—4	—2

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Utility Buys Surge Generator

Said to be the first purchase by a utility company of such equipment, the Duquesne Light Company has secured a complete lightning surge generator and cathode-ray oscillograph of the most recent type. The unit will produce 700,000-volt surges and has a capacity of 0.0135 microfarad. This Westinghouse generator will form a compact unit which may be placed on a truck and applied at any point on the system. It may also be used in laboratory tests. Hitherto such apparatus as has been used in field tests has been the property of the manufacturers and operated by them.

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Frigidaire Brings Out Unit-Type Air Conditioner

Entrance of the Frigidaire Corporation into the air-conditioning field has been announced with the introduction of a diversified line of individual unit-type conditioners suitable for commercial establishments, offices, restaurants, shops, private residences, apartments and hospitals. A public showing of new products was made in Cleveland to members of the American Society of Heating and Ventilating Engineers and of the American Society of Refrigeration Engineers. They are small and compact to meet the needs of those who find the central type of heavy-duty air-conditioning installations necessary in theaters and public buildings much too large for their requirements. The new individual units, it is claimed, will afford a maximum of personal comfort the year round, regardless of prevailing outside weather conditions.

Provision is made to heat, cool and cleanse the air of the room in which the unit is installed. The equipment will lower the relative humidity on hot, sultry days, and in winter, when the heated air becomes dry, will add moisture. Fans effectively deflect and diffuse the air throughout the room, adding to the heating and cooling efficiency of the installation.

Inclosed in a walnut or mahogany cover adapted to modern home and office furnishings, these air conditioners may be installed in place of the conventional hot water, steam or vapor radiator.

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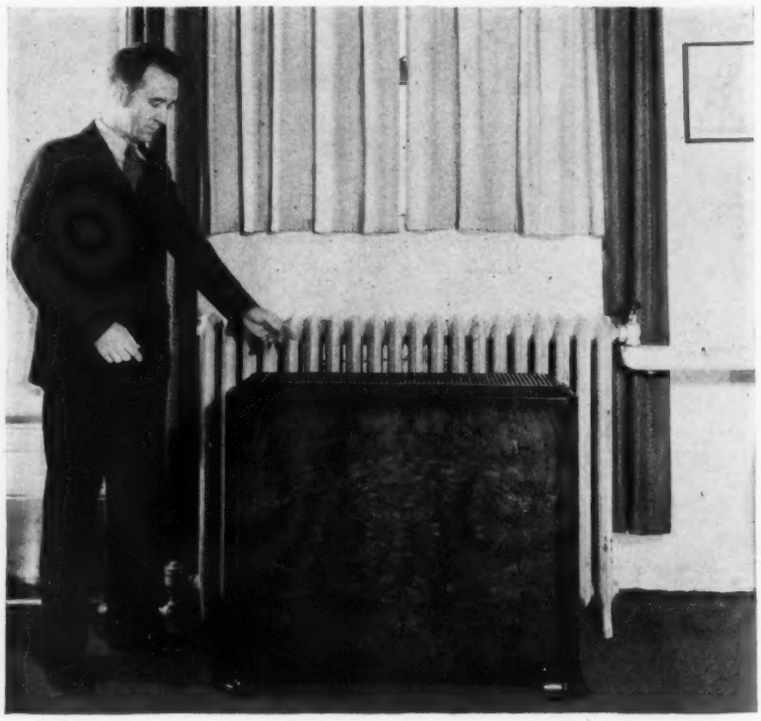
Anglo-American Electrical Co-operation in Australia

Leading electrical manufacturing combines are planning to meet difficulties in 1932 by schemes of closer operation on world markets. The latest arrangement for closer working is one now being completed by Associated Electrical Industries, the forty-million-dollar union of electrical interests of which Sir Felix Pole is chairman, and the General Electric Company. These two undertakings, which are linked together through the International General Electric, have agreed to unite their manufacturing and distributing activities in Australia in a new undertaking.

For this purpose a company has been registered with the name "Associated General Electric Industries." In this



This unit-type air conditioner, made by the Frigidaire Corporation, is compared with the conventional radiator. It performs the function of the radiator and, in addition, cools, dries, moistens, cleanses and distributes the air content of a room.

concern are merged the Australian General Electric, the Edison-Swan, Ferguson Pailin and Metropolitan-Vickers Australian proprietary concerns. The object of the scheme is to co-ordinate the policies of the two controlling organizations and to effect economies on both the manufacturing and distributing sides.

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Allis-Chalmers Earns 96 Cents

The preliminary earnings statement of the Allis-Chalmers Manufacturing Company for the year 1931 shows a net profit, after all charges including federal and state taxes, of $1,256,431, equivalent to approximately 96 cents per share based on the 1,312,252 shares of its stock outstanding in the hands of the public at the close of the year. This compares with $3,604,609 for the corresponding year of 1930, or $2.86 on 1,258,400 shares outstanding at that date. For the December quarter the net was $43,658, compared with $570,086 for the like period a year ago.

Bookings for the current year amounted to $22,687,049, contrasted with $41,606,197 in 1930. Unfilled orders December 31, 1931, aggregated $7,889,334, as against $13,002,924 at the close of 1930, a decrease of 39½ per cent.

Notwithstanding the substantial reduction in earnings in 1931, the company remains in strong financial condition. Net current assets as of December 31, 1931, were $28,029,248.

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Air Conditioning Reaching Mass Demand

THE newest offspring of the electrical industry, namely, air conditioning, is coming to a practical mass-production basis. Manufacturers of air-conditioning equipment are bringing their products within reach of the demand of the masses. Present indications are that relatively inexpensive equipment will be available for homes and commercial buildings almost immediately. Additions to the group manufacturing these products include makers of heating equipment, refrigerators, automotive accessories and other electrical appliances.

Frigidaire Corporation, a subsidiary of the General Motors Corporation, offers three types of self-contained air conditioners. They heat, cool, clean, moisten air or reduce humidity, according to requirements. A 1½-hp. motor operates the compressor and can be placed in the basement so that running machinery will be separated from the location in which the conditioning unit must be used.

Another manufacturer in the field is the Timken-Detroit Company, through its subsidiary the Timken-Detroit Axle Company. This company's unit connected with the regular heating system is designed to provide 40 per cent average humidity and its cost averages $175 installed in a seven-room house.

Other manufacturers in the field include the American Blower Corporation, which has a complete home air-conditioning unit ready using gas, oil or coal for fuel and whose product sells for less than $1,500; the Carrier-Lyle Corporation, subsidiary of the Carrier Engineering Corporation; Holland Furnace Company, etc. The last-named company has a complete air-conditioning furnace for a six- or seven-room house to be marketed at $600 or $700 installed.

Another group of manufacturers, including the Air-Control Systems, Inc., Chicago, and the Lewis Corporation of Minneapolis, provide devices that merely humidify the air. They are made to install in direct connection with existing heating systems. The Copeland Refrigerator Company is marketing an air-cooling system.

There is also a group marketing a low-priced air conditioner in portable units. This group includes the Corozone Company of Cleveland, with a product selling at $41.50; A. C. Gilbert Company, the Air Way Heating Company, the Airite Corporation and the American Radiator Company.

In estimating the size of the market the Copper and Brass Research Association considers that the market includes potential buyers in 2,500 large theaters, 1,000 department stores, 1,500 large banks, numerous chain and independent retailers, hotels and office buildings. It estimates that there are 3,500 air-conditioning plants now operating in 200-odd industries, 300 in theaters and 100 in stores.

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Long Bell Lumber Reorganizing Structure

An attempt to revamp its capital structure so as to avoid recourse to receivership is being made by the Long Bell Lumber Company. The company reports book assets of more than $85,000,000 and has a bonded indebtedness of about $20,200,000. The bondholders' committee, under C. T. MacNeille, an officer of Halsey Stuart & Company, and Philip R. Clarke, president of the Central Republic Bank & Trust Company, appears hopeful that reorganization can be accomplished without recourse to the courts.

New Construction This Week

Heavy-duty motors, controls, electric furnace equipment and other power apparatus will be installed in a branch plant for Ford Motors, at Alexandria, Va. Enameling department included. Cost over $125,000. Bids open until February 20.

A $1,000,000 expansion program for oil refinery of Distillazione Italiana Combustibili, S.A., Mestre, Italy, Arthur G. McKee & Company, Cleveland, Ohio, engineers, will make purchases of electric equipment and other machinery.

Electric heat and power equipment, motors and accessory equipment will be installed at soap and glycerine plant of Lever Brothers Company, Hammond, Ind. Cost over $350,000.

About $1,000,000 will be expended by Keebler-Weyl Baking Company, Philadelphia, Pa., for a baking plant with electric-operated equipment, heat apparatus, traveling ovens, conveying machinery and accessories.

Electric hoisting, crushing, conveying and loading machinery, mining equipment, heavy-duty motors, controls, etc., will be installed for a glass-sand mining plant near Enterprise, Ky., by Tavern Rock Sand Company, Toledo, Ohio. Cost about $250,000.

Power plant equipment and improvements to cost $240,000 are planned by the Hospital Department, Boston, Mass.

Heavy-duty motors, controls, conveying equipment and other electric power equipment will be installed by the Sieloff Packing Company, St. Louis, Mo., in an addition to meat-packing plant to cost about $100,000.

Over $200,000 will be expended by Apex Piece Dyeing Company, Paterson, N. J., for seven new buildings and equipment, including motors, controls, switchboard apparatus, instruments, etc.

Lincoln Electric Gets Order for Motors

The transit department of the city of Boston has awarded to the Lincoln Electric Company of Cleveland the contract for 28 motors to drive the ventilating fans in the new East Boston traffic tunnel now under construction. The design of the tunnel requires seven exhaust and seven intake fans at each end of the tunnel.

The specifications called for motors with a high speed rating of 50 hp. at 450 r.p.m. and a low speed rating of 6¼ hp. at 225 r.p.m. These motors will be or all-welded steel construction similar to those built by the above company for the Alameda-Oakland vehicular tunnel in California.

New Englanders Convene in July

The annual convention of the New England Division of the National Electric Light Association has been advanced this year from fall to summer, the gathering being set for July 11 to 13 inclusive at the Mount Washington Hotel, Bretton Woods, N. H.

Winnipeg May Buy Utilities

Negotiations between the city of Winnipeg and the Winnipeg Electric Company are under way for the purchase by the city of the company's utility interests in Winnipeg, including light and power, electric railway and gas properties. Total value as estimated by the company is $25,000,000, of which the railway represents about $12,000,000 and gas plant $4,250,000. The power properties are thus valued at $8,750,000.

University City Beats Light Bonds

Voters of University City, Mo., on February 2 failed by 341 votes to provide the two-thirds majority necessary to approve a bond issue of $500,000 for a municipal street-lighting system. The vote was 1,925 for and 1,434 against the issue. This is the first time in the history of the community that a municipal improvement bond issue has been defeated by the voters.

Wisconsin Gas & Electric Expands

Authority has been given to the Wisconsin Gas & Electric Company of Racine by the Wisconsin Public Service Commission to purchase the electrical system and other property of the Wisconsin Public Utility Company, serving West Bend. The transaction will give the purchasing company control of further business in the lake shore section.

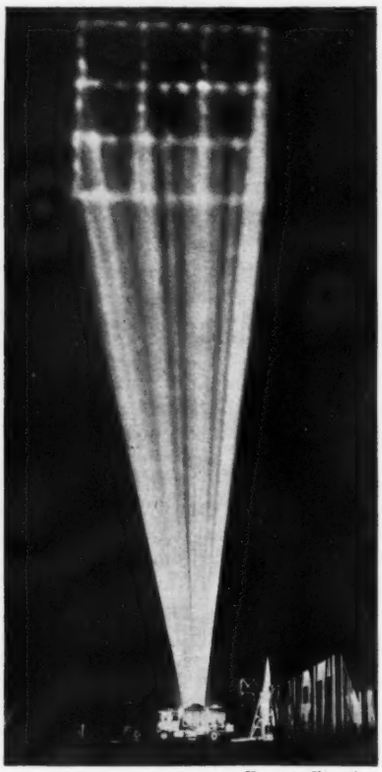
City Plant Stops Merchandising

Lincoln (Neb.) officials announce that with the disposal of stocks on hand the city will retire from the business of selling electrical appliances. Commissioner Schroeder, in charge, says that he is in accord with the principal contained in the bill to prohibit power companies from selling merchandise which failed in the last Legislature. The department in future will sell only lamp bulbs and fuse plugs.

Gov. Meier Assails "Power Trust"

Speaking at a luncheon given in his honor at New York City, Governor Julius L. Meier of Oregon pleaded for the development of the water power of the Columbia River. By means of a government loan, which could be paid off in 40 to 50 years, he said, the people of his state could have the benefit of the lowest possible power rates. "The power trust has kept the Northwest back by pyramiding rates and investments," Governor Meier declared, citing the respective tariffs of the Tacoma municipal plant and the private companies in Portland as proof to his mind of the contention he makes.

NO MORE AIR RAIDING?



—*Keystone View Co.*

A British army man has perfected what he calls the most powerful searchlamp on earth and predicts that in case of war it would make the escape of night air raiders impossible.

Mexicans Against Duty on Energy

Merchants and other consumers of electric light and power in Mexican cities near the border have petitioned the Department of Finance for repeal of the present duty on energy imported from the United States.

Oklahoma Board Seeks Data

Holding companies which own public service corporations operating in Oklahoma are to be asked to produce books and records needed by the Corporation Commission of that state in investigating utility rates. Efforts will be made, Chairman Paul A. Walker announces, to bring all earnings of the Oklahoma companies into the light and to enforce jurisdiction, through state action, over holding companies in other states as regards their Oklahoma interests.

New Hampshire Utility Inquiry

The Public Service Commission of New Hampshire has announced that a questionnaire has been sent to all operating utilities in that state to ascertain whether they have made loans to their parent companies and to learn the facts concerning other possible intercompany transactions.

Hahatonka Damages $350,000

A jury in the United States District Court in Jefferson City, Mo., has awarded the Snyder estate of Kansas City $350,000 in its suit against the Union Electric Light & Power Company for damages said to have been done to Hahatonka, Ozark beauty spot, by the Bagnell hydro-electric reservoir. A condemnation commission had awarded $143,000 to the estate, which asked for $1,000,000. (ELECTRICAL WORLD, January 16, page 128.)

New Muscle Shoals Bulletin

Issued by the National Popular Government League, with an introduction by Senator Norris, "Muscle Shoals Bulletin No. 152," just out, shows, the Senator says, the "absolute fallacy" and "incorrect and misleading deductions" of the recent report of the presidential and tri-state commission. "Incidentally, it also annihilates the arguments made by President Hoover in his message vetoing the Muscle Shoals bill which passed the last Congress." These contentions are elaborated in 25 typewritten pages.

Puyallup to Drop Ownership Idea?

After a number of suits to buy the plant of the Puget Sound Power & Light Company in Puyallup, Wash., the Mayor now proposes that the company pay the city $25,000 in cash and consider the suit a closed matter. This offer follows an unsuccessful effort by the city to sell bonds to cover the purchase price of the power company's property. President McLaughlin of the company is understood to be willing to repay the city with interest what it has spent in condemnation suits.

Paris-Orleans Road to Electrify

Some time this year the Paris-Orleans railroad will start work on the electrification of the railway, according to Trade Commissioner Paul Malone, reporting to the Department of Commerce. The French company (Alsthom) has received an order to install and equip all the distributing centers of lesser importance at 1,500 volts on the line from Orleans to Tours. Energy at 220 kv. is to be supplied by the plant of the Massif Central over a line to be built this year.

Rectifiers for New York Subway Total 153,000 Kw.

One of the largest installations of mercury-arc rectifiers in this country, and probably in the world, is being made in New York City to supply direct-current power for the operation of the new Eighth Avenue subway in the boroughs of Manhattan, Queens, the Bronx and Brooklyn. Part of this subway is expected to be in operation in the near future, the portion now contracted for and under construction including more than 200 track-miles.

For supplying third-rail power to this system 51 mercury-arc rectifiers, totaling 153,000 kw., are either under construction or already installed, and synchronous converters rated at 53,000 kw. are ready for operation in five surface substations.

The location of the rectifiers below street level is unusual. Underground rooms, constructed of reinforced concrete, adjacent to the subway, have been built at depths varying according to conditions. All the switching equipment is automatic, with remote supervisory control, and the distribution of the various units along the right-of-way is such as to minimize as far as possible the necessity for expensive feeder equipment.

Each rectifier will have a nominal rating of 3,000 kw. at 625 volts and will carry double-load current without injury for a period of five minutes. The units have twelve anodes each, operating in twelve-phase relation, and are supplied with alternating current from transformers stepping down the 13,500-volt or 27,000-volt, three-phase, 60-cycle supply. The apparatus is being supplied by the General Electric Company.

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Archaeologists Put Photo-Electric Tube to New Use

A new use for the photo-electric tube has been found by the National Museum of Canada at Ottawa. This concerns the classification of scientific specimens on which information is incomplete. Museum officials are confronted with the task of classifying and cataloging thousands of Stone Age implements acquired from the European collections for which the field notes have been lost.

It occurred to the archæologists that chemical analysis of the articles would tend to show to what geological area they belonged. But they could not conduct regular chemical analysis without destroying the implements. The "electric eye" solved the problem. Under its ultra-violet rays various chemicals have distinctive colors indistinguishable in ordinary light. The archæologists knew in what years the specimens had been collected and what areas had been covered. It remained to compare the geological secrets of the stone implements revealed by the rays with the known geology of these areas. In this way, by degrees, information which otherwise would have been lost forever is salvaged.

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Starting Large Generators Without Aid of Heating

An improved method of quickly and safely starting up large steam turbo-generators without any preliminary heating has been successfully introduced by the Brown Boveri Company of Baden, Switzerland. The method is that of maintaining the turbine at a temperature above or near the saturation temperature of the steam supply, by means of hot air circulated round or through the turbine. Then, when starting up a generator set, no excessive temperature differences or heat stresses occur and steam condensation is prevented. The air is drawn by a fan through either a steam or an electric heater and circulated round the turbine below the casing lagging. In this way, it is claimed, in view of the fact that turbo-generator sets can be restarted in about one minute, these machines can be shut down more frequently than otherwise and so give to the station operator greater choice as to which of the installed units shall be brought into use. The plan also enables a standby set to be quickly brought into operation to provide for a sudden increase in the load on a station.

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Electropneumatic Control Speeds Ore Bridge

Application of electropneumatic control to the contactors in an ore bridge of a useful load capacity of 17 tons in a large Pittsburgh steel plant has speeded the permissible operating rates of both bridge and auxiliaries and has also introduced smoother operation. Electropneumatic contactors are said to be six to ten times faster in operation than the large magnetic contactors of equivalent rating.

Operation of the bridge has likewise been facilitated by the incorporation of pneumatically released, spring-set brakes which permit gradual application of brakes, better control of bridge placing and easy deceleration in case of power failure. They are a marked advance, therefore, over the older style of solenoid-operated brake.

Bucket-hoisting speeds of 235 ft. per minute through an average hoist distance of 35 ft. are attained. A trolley speed of 800 to 900 ft. per minute and a bridge free-running speed of 140 ft. per minute are used. Time for one complete unloading cycle, with a 17-ton load, averages 54 seconds. The electropneumatic controls are of Westinghouse manufacture.

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WHERE NO OTHER SHOVEL COULD OPERATE

—Courtesy John A. Roebling's Sons Co.

On the 1,135-ft. level in the rock-salt mine of the Detroit Rock Salt Company this electrically driven shovel economically and without fumes or dirt operates in large-scale production. It is one of a group of three-quarter-yard and one-quarter-yard shovels used there.

EDITORIALS

L.W.W.MORROW
Editor

Balancing the budget is a two-sided problem

GREAT and urgent though necessity may be to keep down taxation, it is virtually certain that there will be higher taxes and that some impost on products or transactions today exempt from federal levies will be made. As Representative Crowther, a member of the ways and means committee, said last week:

"Out of all the people who have appeared before the committee, here is the record: Radio tax, no; admission tax, no; stamp tax, no; automobile tax, no; oil tax, no; gas tax, no; electric tax, no; sales tax, one yes and the rest no; gasoline tax, no; cosmetics tax, no, and telephone tax, no."

If—and that if is the point of our contention—governmental expenditures are to be continued in open-handed largess, then both higher taxes and further large-scale borrowings must be made. Some one must pay. Presumably these great outpourings of federal funds are for relief and the furnishing of employment to relieve distress and promote business activity, but it has been estimated that in such projects 70 per cent of the dollar goes for land and material expenditures and only 30 per cent to labor. If it is for relief to individuals and to commerce that we are so earnestly working, our political solons appear to follow most devious and doubtful paths.

The menace that today faces the electric industry, and virtually all others, is the menace of governmental expenditures rather than that of federal taxation. Government has run wild. Let us have higher taxes if we must to offer direct relief to distress, let us distribute supplies and not money to the needy, but by all means call a halt on borrowing which will stifle national growth for years to come and burden coming generations with a debt heavier than that of war—the debt of spendthrift profligacy with public funds. It is public and private debt that even now prevents the return of normal prosperity. Why add to it?

A way of disproving absentee landlordism

ONE promising adjunct of the discernible trend toward decentralization of management in the electric utility field is the prospect of bringing local personalities back into the picture. Absorption of the local operating utility into a regional unit meant in many instances a complete change in the complexion of its board of directors, few if any local men being retained. There was thus lost to the utility an element of community contact that, restored, would dissipate much of the indifference that typifies the public attitude toward utilities.

Bankers, merchants and manufacturers intent on the welfare of a community aid much as utility directors to mold the local attitude into that of acceptance and confidence. While public relations are, on the whole, good with respect to local utilities, the national picture leaves something to be desired. Any measure restoring the participation of local men in the conduct of local enterprises would be a distinct contribution in both directions.

In the last analysis electric service is a community matter which has become nationalized only because of the manifest opportunities for economy afforded by co-ordination of power supply and diversification in financing. In so far as the service preserves a predominant local interest

it deserves in its management the participation of local figures who are part of the fabric of the community and can incorporate its sentiment and best business judgment in the conduct of the utility enterprise.

Why not lightning tests?

OPINION and theory on transmission have arrived at the stage where lightning-proof lines are practical possibilities. This has meant new experiments and facilities for impulse and surge tests and new levels of insulation for all equipment. It seems advisable, therefore, to use standard impulse tests on all line and station apparatus. Why should not the proper committee develop a slow and a fast impulse test that might be standardized and placed in equipment specifications? No one knows just what this test will determine other than the insulation factor of safety for slow and fast surges, but this in itself will be of use in fixing insulation levels and insulation grading.

Standard parts aid apparatus development

RECENTLY developed electrical apparatus utilizes standard parts to a striking degree, in contrast with earlier productions. The use of conventional components in new combinations lowers the cost of development and manufacture, enhances sales appeal and insures better service and lower maintenance costs in commercial operation. This trend is extremely healthy and should be encouraged by users of electrical equipment. Manufacturers who select well-tried elements in making up new material and equipment assemblies may find that the outward appearance of certain products lacks originality, but this weighs lightly with purchasing engineers seeking reliable service no less than efficient performance.

It is better that pride of authorship in designing should be sacrificed to conventional methods where these will serve the purpose. In the long run material is conserved, space saved, safety enhanced, inspection facilitated and manufacturing processes are simplified by this policy. Years ago much new equipment was bulky, misshapen, roughly finished and rather experimental in appearance. Today the most advanced products of recent development resemble lines familiar to the art. These reflect a new manufacturing precision which builds expectation of their success even before they are tested by field service. Switchboard, circuit-breaking, protective and measuring apparatus emphasize this trend to a remarkable extent at the present time.

Unprofitable customers can be reduced in number

THE poor will be always with us, says the biblical pronouncement, but that does not mean that utilities must always contend with unprofitable domestic customers to the extent that has prevailed in the past—certainly not if the steps taken by the Ohio Public Service Company can be followed by other organizations.

Faced with twelve thousand unprofitable domestic customers—or about 25 per cent of all its consumers in this class—the company decided from past experience that only slight inroads could be made on this group by the ordinary methods of appliance sales. Furthermore, the usual kitchen-unit campaigns had failed to arouse its members to action for better kitchen lighting. Yet it was certain that a desire for better lighting existed if the price were not too high. Consequently a metal-bowl reflector with three welded wings that could be slipped over a 150-watt PS-25 lamp only was devised and offered with the lamp for 89 cents. No installation cost was involved.

The unit was not of a character to compete with the more attractive and permanent units in better-equipped homes, but it had a sufficiently good appearance and served its purpose so well that more than 50 per cent of the unprofitable customers bought the combined unit in twenty days, adding about $3 energy revenue a year to subnormal bills.

Here is an example of what can be done with customers who cannot be induced to purchase the usual class of merchandise and fixtures. The plan did not take business from fixture manufacturers, because the customers concerned were not in the market for better fixtures, although they may be educated to them by experience with improved

lighting. Contractors and dealers had the opportunity to sell these units at the same commission as utility salesmen and to pick up other business at the same time.

Apparently we need some Fords to introduce Lincolns in the electrical business, but eagerness to sell should not prompt pushing the lower-class equipment where a desire can be created for the better class.

Air conditioning means "cold" control

THERE is not much question that the prompt acceptance of electric refrigeration was as much a matter of comfort as it was of health through better food preservation. Getting rid of the iceman and getting rid of microbes were companion incentives. The surprising success of the program raises the question how the next venture will best succeed. Will air conditioning sell on the basis of health or of comfort?

The answer is both—with comfort perhaps in the lead. But that is no reason why the health aspects should be ignored. A start should be made now to assemble the physiological evidence in favor of cleaned and humidified air. There will inevitably be a controversial period, but from it will emerge sound conceptions of germ reduction and cold control. Cold control has one meaning in refrigeration. *Cold* control in air-conditioning language will come to mean the maintenance of an atmospheric condition of purity and moisture content which will cut to insignificant figures the economic loss and physical discomfort from "colds" and their sequels.

Some utility men believe that air conditioning will afford a receptive market long before there has come any standardization of methods for accomplishing it or any unity of purpose in fostering it. Hand in hand with the lagging mechanical and commercial development should therefore go a physiological campaign to convey the idea in terms of health. The dream that air conditioning will provide the means of giving the home a California climate whatever the outdoor torridity of the summer may be can wait for its fulfillment until the more promising task of air purification and humidification in winter has become an accomplished fact.

Local electrical leagues—What will they do?

WITH the Society for Electrical Development virtually abandoned by the industry, what is to become of the local electrical leagues? It is easy enough to say that they will go on independently to do the local work. But the guidance and service which the S.E.D. has rendered to the leagues have been one of their greatest resources. This resource will no longer be available.

There were about a half a dozen leagues in the country when the society began to promote their organization. Today leagues are at work in well over a hundred cities. They have had a profound influence upon the relations between the power company and dealers in many difficult situations. They have been a powerful force in the development of the market for electric service. They offer the best possible agency for bringing peace between the public utilities and the hardware and department stores if the proper measures in merchandising policy are taken by the power companies to establish the basis of an accord. It is of the utmost importance to the entire electrical industry, therefore, that league work should continue. Ask electrical men in Philadelphia, Cleveland, Chicago or a dozen other localities.

The league service of the S.E.D. has embraced far more than the clearing of information and the promotion of campaigns and standards, such as "red seal" wiring. It has enabled each league to benefit from the activities of the rest, but beyond that it has made available records, knowledge and judgment based on nearly twenty years' intimate contact and study of league operation and experience. This has been invaluable in solving local problems and formulating local promoton programs. With the S.E.D. league service staff disbanded this resource is gone.

There is a League Council which has been advisory to the society. This league staff might be retained with its files and the work continued if there were funds. But because of the local thinking in each league it would be difficult for the council to finance such a service from the leagues themselves. It should not be left to that if league work is valuable to the power companies, manufacturers, wholesalers, contractors and dealers of the electrical industry from the national viewpoint.

Fairchild Aerial Surveys, Inc.

The line patrol delivers an ounce of prevention

Sweeping along at 80 to 95 miles an hour in this plane, two Texas utility engineers recently made a test flight to gage the value of such service in transmission line maintenance.

The efficiency of the air patrol has long since been proved where broken conductors, sleet-twisted towers, general storm damage or major difficulties of a similar nature are involved, but this was a test of preventive patrol against causes of possible future outages. Observations, it was found, could easily and most rapidly be made of broken insulators, material entangled in conductors and insulators, such as a bird's nest or a boll of cotton blown from a nearby field, and even of the condition of the small diameter ground wire used on some novel pole lines. Once again are the probabilities of service continuity definitely improved.

Assuring System Stability and Service Continuity by Relays

By H. D. BRALEY

Assistant Engineer Electrical Engineering Department, New York Edison Company, New York, N. Y.

What can be done to guard against a complete system shut-down due to trouble in a generating station?

How should generating station ties be protected to prevent their loss during system trouble except for actual faults on the ties?

How can protection be improved to increase speed of fault clearing to safeguard the stability of the system?

What can be done to decrease the severity and duration of faults on underground cable systems to limit the damage to equipment?

What can be done to improve protection on consumer's equipment to prevent interruptions resulting from dips in system voltage at the time of system trouble?

OF SYSTEM stability it can be said that the allowable time for clearing faults to prevent two generating systems or units from losing synchronism is fixed largely by the inherent stability of the system, the severity of the fault and its duration.

It is convenient to place systems in two general classifications in studying stability. In the first class there are metropolitan systems which usually have a higher degree of stability due to the large number of generating units which are interconnected by ties of comparatively low impedance and in the second class those systems which are connected by long, high-voltage, high-reactance transmission lines and which have comparatively a lower degree of stability—other things being equal. Studies of metropolitan systems made by R. D. Evans of the Westinghouse Electric & Manufacturing Company show in a general way the limits of fault severity and time of clearing which may not be exceeded if stability is to be maintained.

The sensitivity of long, high-voltage transmission circuits to faults is considerably greater than in metropolitan systems as the high reactance of such ties results in a much larger initial angle between the two generating systems and hence the time required to clear a fault to maintain a given amount of load transfer over the remaining circuits is greatly reduced. This is well illustrated by Fig. 2, showing the results of an actual study made by General Electric engineers on a typical high-voltage system.

The limitation of damage at the fault point is also of no inconsiderable importance, for it is not only a matter of reducing the repair bills but also the time required to restore equipment to service; in other words, it affects service continuity. While the loss of an extra foot or 5 ft. of cable is of no consequence in itself, distinct disadvantages are reflected by the longer time required to locate the fault, clearing débris from the duct run and the possible damage to other conductors, splicing chambers, etc.

Network transformers are normally tied in solidly on a high-tension feeder which has a capacity many times in excess of the network transformer. The feeder protection is usually too insensitive to provide any protection against a fault in the transformer winding, with the result that such faults may result in complete loss of the transformer and extend the trouble to adjacent equipment before it is finally cleared. For example, a ground fault in the middle of the high-tension winding of a 500-kva., 13,200-volt network transformer may result in a ground current in the order of 50 amp., but a 10,000-kva. feeder protected by overcurrent relays only may have a minimum operating current of 1,000 amp. Evidently this is no protection whatever to the transformer.

From the questions propounded we may establish the fundamental requirements which every good protective scheme should satisfy. These are:

1. Act to maintain the continuity of service.
2. Limit the disturbance to the system.
3. Limit the damage at the point of fault.

We may ask, then, how must the protective equipment function to effect the desired result and how is it effected by the system design and operation? There are three important functions:

First, it must detect the presence of a fault. This is a measure of sensitivity, or, in other words, the response to changes in the quantities which the relay measures.

Manifestly if the relay must measure a quantity which

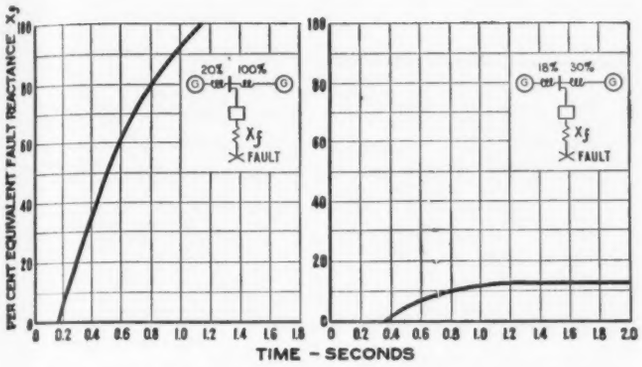
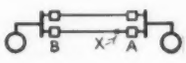


Fig. 1—Stability limits for two typical metropolitan systems with steam turbine generators and no voltage regulators

These curves show the general relation between the magnitude of the equivalent fault reactance and allowable time for clearing the fault to prevent loss of synchronism between the two generating systems. All reactances are based on the rating of the generator having the lowest reactance.



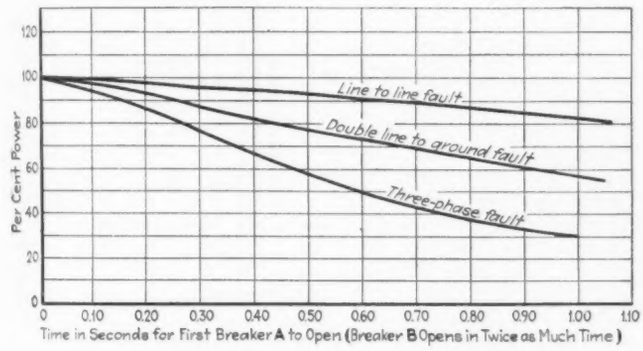

Line to line fault
Double line to ground fault
Three-phase fault
Per Cent Power
Time in Seconds for First Breaker A to Open (Breaker B Opens in Twice as Much Time)

Fig. 2—Switching time curves for different faults

A typical high-voltage interconnection study showing the effect of fault clearing time on the amount of power which can be maintained on the remaining circuit without losing synchronism. The effect of the different types of faults is particularly significant. All faults occur at "X."

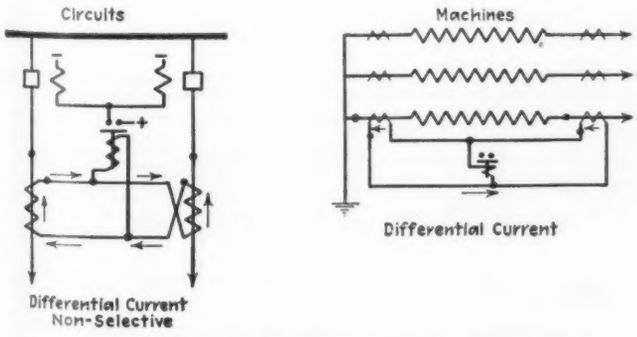


Fig. 3—Inoperative under balanced conditions or balanced faults external to protected circuit

The fundamental principle of the simple current balance scheme. The relay is connected to points which have no difference in potential, and no current flows in the relay as long as the two line currents are equal in magnitude and direction. The relay therefore measures a quantity which is normally zero except under fault conditions.

is in excess of a certain value which is already large it cannot be very sensitive. For example, if an overcurrent relay must operate on current in excess of normal load current it must have an initial setting which is far in excess of normal load current, otherwise it may operate on momentary harmless overloads, etc.

Why is it not common sense, then, to measure those quantities which do not ordinarily appear except under fault conditions so that the relay may measure values with reference to zero instead of a normally large value?

One method of doing this which is extremely simple in principle is by the balance method. We may balance the current in A phase of one circuit against the A phase of another circuit which normally carries the same current or a current which is normally proportional. This principle is illustrated in the simplest form by Fig. 3 as applied to two feeders or a machine. It can also be extended to any number of identical feeders which are operated in parallel.

The line or phase current unbalance is limited in sensitivity, however, when applied to two feeders by the necessity for setting the initial unbalance at a point above normal load current to prevent tripping out one line when the other of the pair is switched out at one end. This effect can be minimized by providing in one instance a voltage restraint automatically to raise the minimum operating current under normal voltage conditions and in another by designing the relay in such a way that the pick-up is automatically increased when one line of a pair is disconnected. Fig. 4 shows connections and characteristic performance in the first case and Fig. 5 in the second.

A still more sensitive method is to balance the neutral currents, as these are normally zero, with balanced loads regardless of the load on the feeder (Fig. 6). These connections will be recognized as the application of the simple differential principle which has long been used for the protection of transformers and generators.

If loads are tapped to feeders at intermediate points between stations a sensitive balance between phase currents is evidently out of the question, since such loads act in the same manner as faults on the protected section to upset the balance.

One may, however, still balance the neutral currents even with tapped loads provided they are taken off through delta transformations, as ground faults on the branch circuit are not reflected in the tapped circuit (Fig. 7). If, however, the tapped loads are taken off without any transformation or they are taken by means of star-star transformations, even this protection may not be used to advantage where the tapped feeder must not be tripped by faults on the branch circuit. This is well illustrated by Fig. 8, in which a feeder is tapped to a substation which supplies, for example, a loop feeder circuit having such long time settings as 0.7 and 1.2 seconds.

The second function of the protective equipment is to determine the location of the fault. This is a measure of selectivity or the ability to distinguish between a fault on the protected section and one on another part of the system. It protects against tripping out unfaulted feeders. The adjustment of relays for different values of current or the use of graded time settings, while very useful in obtaining selectivity, is open to the serious objection of insensitivity and long time, particularly as the maximum fault currents generally occur at the gen-

erating end of the feeder, where the need for the sensitivity and high speed is the greatest.

Where it is possible to arrange the feeders by pairs the current balance principle is also well suited for selective operation. The relays on the protected section are not affected by faults on other parts of the system and avoid the necessity for setting up a long series of graded time settings.

Some protection, however, must also be provided for back-up protection when one line of a pair is out of service and for other applications where single-line operation cannot be avoided. The distance-measuring principle is well adapted for this purpose, but it cannot be applied indiscriminately. Fundamentally, this arrangement measures the ratio between voltage and current. The relay is designed to operate when the ohms measured are equal to or less than the short-circuit impedance of the line from the relay to the point of fault (Fig. 9). If loads are tapped to the feeder the relay will operate for faults beyond the load-tapping point unless a lumped impedance of sufficient magnitude in the form of reactors or transformers are located at the tap point (Fig. 10).

Ground faults make impedance relaying difficult

Faults involving grounds present a much more difficult problem for distance relays, since the impedance of the ground return path is not a constant value, even in the same territory, due to the effect of seasonal changes of earth conductivity. Other factors, such as mutual coupling effects and fault impedance, also act to make exact advance determination of such impedances uncertain. It would appear, therefore, that considerably larger "factors of ignorance" would have to be used until more accurate data are available or until a distance ground relay is designed which will be unaffected by impedances other than those of the line itself.

Overcurrent ground relays or watt relays may be used to protect against ground faults. To date these have found more favor than distance-measuring relays for this purpose, for the reasons mentioned previously (Fig. 11).

Pilot wire protection, which is simply an adaptation of the differential or current balance scheme, is the only arrangement which we have today which provides simultaneous clearing of faults at both ends of the circuit for all fault locations on the protected section. The use of pilot wires is usually prohibitive, except on short lines, from the standpoint of cost and is also subject to certain engineering difficulties on long lines.

Some progress has been made with high-frequency carrier-current systems using the power conductor as a pilot wire and seems to offer considerable promise for the protection of high-voltage circuits, particularly for comparatively short sections where selective operation of distance relays may be difficult.

No system protection can prevent the dropping of loads caused by the operation of instantaneous low-voltage releases on consumers' equipment. In this instance time delay is actually beneficial. Motor controllers are now available with time-delay undervoltage attachments which should eliminate a large majority of interruptions of this nature. It will be distinctly of advantage to both the power company and the consumer to make greater use of this improved equipment.

The third important function of the protective device

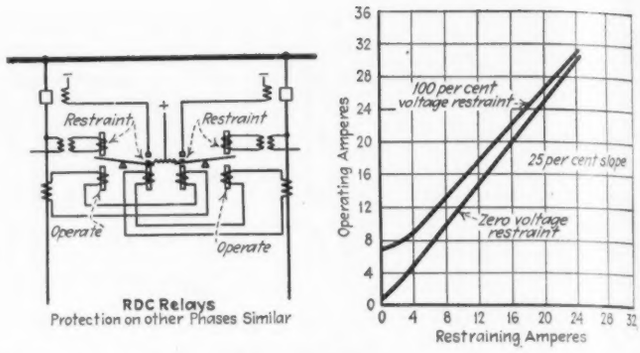


Fig. 4—Percentage differential phase current instantaneous—selective operation—voltage and current restraint

The voltage restraint acts to decrease sensitivity when no fault exists, but increases sensitivity under fault conditions. The current restraint is a safeguard against faulty operation since it compensates for differences in current transformer ratios or for unequal line currents resulting from differences in line impedance. Curves show operating characteristics when the two currents flow in the same direction in the lines.

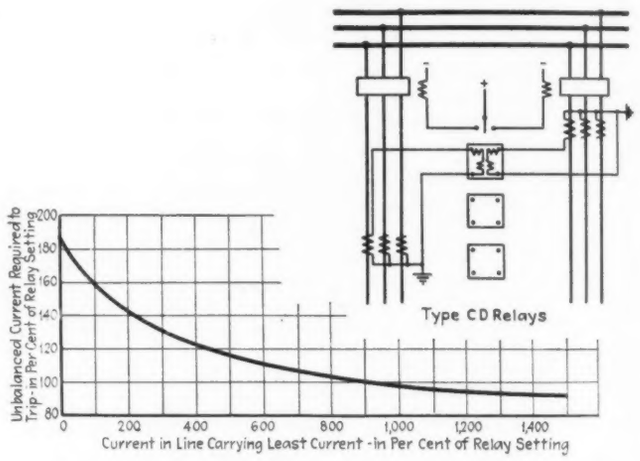


Fig. 5—Vector difference phase current balance with current only

The fluxes set up in the relay by the currents from the two lines is balanced under normal conditions of no fault. The operating current is automatically increased when one line of a pair is out of service as shown by the characteristic curve. No potential connections are required. Currents in the two lines in the same direction.

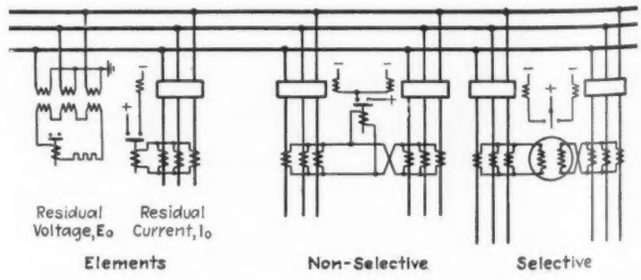


Fig. 6—Residual (zero sequence)

Protects only for line to ground faults but is more sensitive than phase balance since the two neutral currents are normally zero when no fault exists on the system. The relays may therefore be set well below normal load currents without the necessity for voltage restraint. Either line of a pair may be switched in or out under load conditions without affecting these relays.

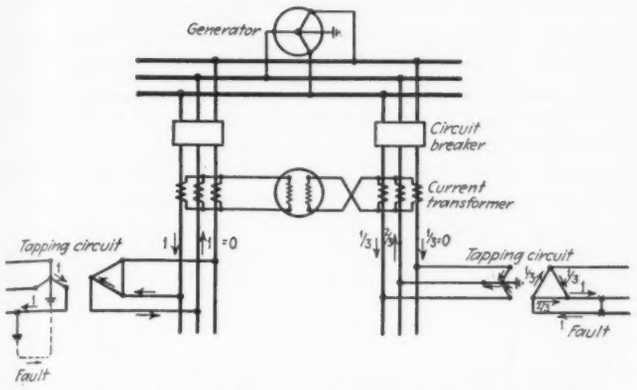


Fig. 7—Tapped loads taken through delta transformations do not prevent balance of residual currents

When loads are tapped to paired feeders with neutral current balance protection a fault on the branch circuit does not affect the balanced neutral relays on the main circuit provided the tapped loads are taken through delta transformation. The vector sum of such currents is zero in the main circuit.

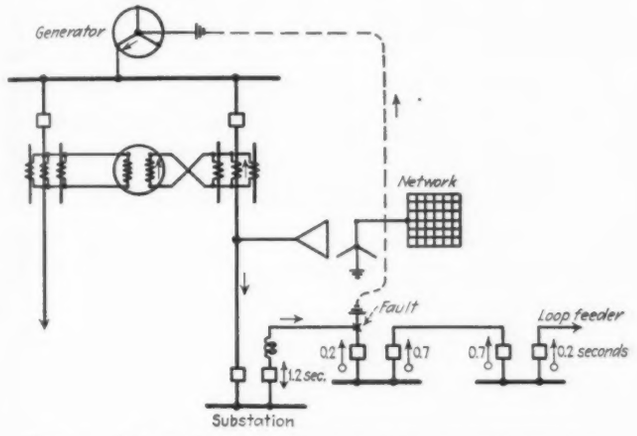


Fig. 8—Tapped loads without delta transformation prohibit use of balanced protection

This diagram illustrates how the major circuit layout limits the application of desirable protective equipment. It is not usually desirable to trip the main circuit for a fault on the loop circuit.

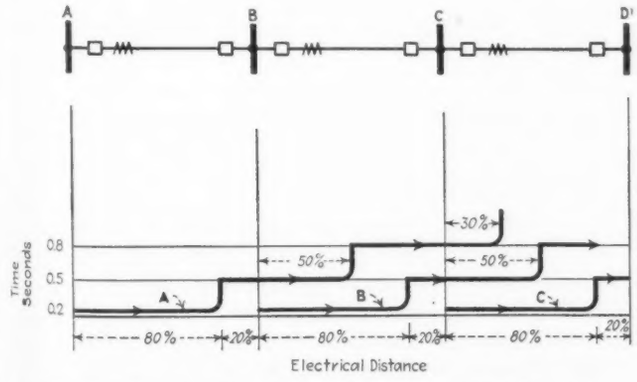


Fig. 9—Fundamental time-distance principle with directional control

The point at which the curves turn upward is the balance point beyond which the element will not operate. At this point the restraining action of the voltage on the relay operating mechanism just balances the operating action of the fault current. The operating time of the first element is set as the lowest practicable value, but the time of the second and third steps are controlled by definite time devices. These curves represent total time (relay and circuit breaker) required to clear a fault with high-speed protective equipment on a 60-cycle application.

is that it shall switch out a defective section in the shortest practicable time. There has been considerable publicity recently about high-speed switching and relaying, so it might be interesting to see just what is meant by high speed and normal speed, etc.

The minimum time in which a fault can be cleared with the usual induction relays and circuit breakers is in the order of 0.4 to 0.5 second. High-speed relays are available which will operate in ¼ to 3 cycles. High-speed breakers are also available which have a rated operating time of 8 cycles, so that an over-all time in the order of 0.15 to 0.20 second can be realized, or something less than half of that formerly attainable. High-speed protective equipment was developed primarily for the protection of systems connected by long high-voltage transmission circuits, which, as previously mentioned, are unusually sensitive to faults. As shown in Fig. 2, it may be necessary in some cases to clear faults within 0.2 to 0.3 second in order to maintain the desired amount of power flow over the remaining unfaulted circuits to prevent loss of synchronism.

Relaying involves adaptation to system requirements

It would appear entirely logical to expect more extensive application of high-speed protection even on circuits where the use of longer fault clearing times would not jeopardize the stability of the system, since there are distinct advantages in limiting prolonged heavy joint circuits both from the standpoint of equipment damage and the reduction of life hazard and also in limiting the disturbance to the system voltage. In other words, high-speed protection fulfills all three fundamental requirements which every good protective system should satisfy. The tendency is undoubtedly toward high speed in fault clearing. Faulty equipment can do the system no good, but it can do plenty of harm, and should therefore be disconnected as promptly as economic limits will permit.

It is apparent from the foregoing remarks that the application of protective equipment which is capable of giving the best results is largely influenced by the arrangement of the major circuits.

To summarize, then, improved protection may be obtained by the use of:

1. Differential protection of all major circuits in stations.
2. The use of balance methods for the protection of feeders where they can be arranged for parallel operation.
3. The use of distance relays for phase protection of single circuits and ground relays for protection of ground faults.
4. Arrangement of circuits to permit the application of these principles.

It may be of passing interest to refer to a list of relays which are available. Fig. 12 shows that 63 combinations can easily be made. This makes no pretense to completeness, but gives a general conception of the principal types available.

The last question is, when shall the protection be determined?

The system is usually planned and laid out in accordance with the desire to establish certain features which are considered to meet the requirements for efficiency, flexibility and economy and the protective features are added to fit the system as best they may.

In the writer's humble opinion this is fundamentally the wrong basis. If protection is applied to the design after the manner of pinning the tail on the mule, it is only natural to expect that we may sometimes obtain equally ludicrous results, and with about the same chance of doing a 100 per cent job. Why is this so? Mainly because:

1. The layout of the main circuits is not adapted to the application of available equipment which will meet the fundamental requirements for good protection.

2. Inadequate or insufficient switching facilities to permit isolating the fault without jeopardizing the service.

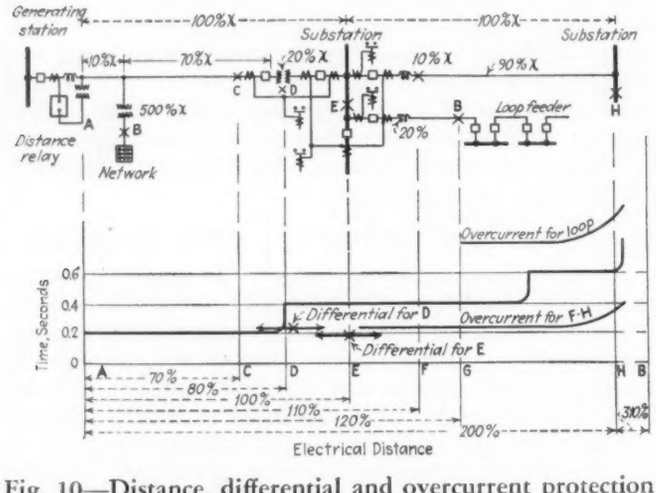


Fig. 10—Distance, differential and overcurrent protection not selective with loop feeder relays

The major circuit arrangement may also limit the application of the distance relay. In this case the distance relay at A is not selective with the time-overcurrent relays on the loop feeder at the substation, as shown by the curves. The difficulty may be obviated by using larger reactor, distance protection or pilot wire protection on the loop feeder.

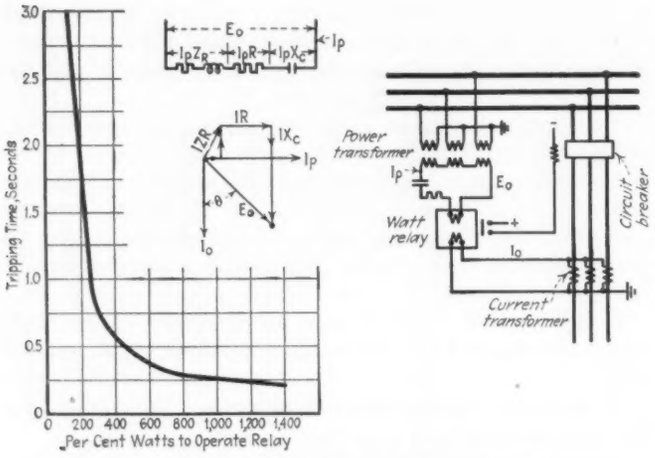


Fig. 11—Residual watts (E.I.). Directional inverse time characteristic

The residual (zero sequence) watt relay may be used to provide protection against ground faults where directional control is desirable. The phase relations may be adjusted for the particular line to give maximum relay torque and therefore maximum sensitivity, as shown by the vector diagram. Improper direction indication may be given, however, for double line to ground faults on different phases, e.g., simultaneous line to ground fault on A conductor of one circuit and B conductor of another circuit. This relay may also be polarized by current as well as potential. Simple overcurrent high-speed sensitive ground relays afford a high degree of protection for simple radial circuits.

ELEMENT OR DERIVATIVES	COMPONENT OR SYMBOL	TYPICAL RELAYS		QUALIFYING FACTORS						TOTAL COMBINATIONS
				MAGNITUDE		TIME				
		G.E.	W'SHSE	ABOVE NORMAL	BELOW NORMAL	INST.	DEF	INV	INV DEF	
VOLTAGE	E_0	IAV/PQ	CV/SV	1	0	1	1	0	1	3
	E	IAV/PQ	CV/SV	1	1	1	1	0	1	6
CURRENT NOTE #1	I_0	IAC-PQ	CO-SC	1	0	1	1	1	1	4
	I	IAC-PQ	CO-SC	1	0	1	1	1	1	4
WATTS (DIRECTIONAL) NOTE #2	$E_0 I_0 \cos\theta$	ICP	CW	1	0	0	0	1	0	1
	$E\ I \cos\theta$	IKP	CW	1	1	1	0	0	1	4
	$I_0 I_0' \cos\theta$	ICC	CWC	1		0	0	1	0	1
OHMS (DISTANCE OR IMPEDANCE)	E/I	IJX	CZ/MZ	0	1	1	1	0	0	2
	$E/I \sin\theta$	GAX	—	0	1	1	1	0	0	2
CURRENT — CURRENT (BALANCED OR DIFFERENTIAL) NOTE #3	$I-I'$	IAC/PQ	CO-CD	1	0	1	1	1	1	4
	I_0-I_0'	IAC/PQ	CO-CD	1	0	1	1	1	1	4
	$\%\,(I-I')$	IJC/RDC	—	1	0	1	0	0	1	2
	$\%\ I_0-I_0'$	IJC/RDC	—	1	0	1	0	0	1	2
WATTS + CURRENT (DIRECTIONAL CURRENT)	$E\ I \cos\theta + I$	IKP+IAC	CR3+CO	1	0	1	1	1	1	4
	$E\ I \cos\theta + I_0$	IKP+IAC	CR3+CO	1	0	1	1	1	1	4
	$E_0 I_0 \cos\theta + I_0$	IBC	CRC	1	0	1	1	1	1	4
WATTS + OHMS (DIRECTIONAL DISTANCE)	$E\,I \cos\theta + E/I$	IGX	CZ/MZ	0	1	1	1	0	0	2
	$E I \cos\theta + E/I \sin\theta$	GAX	—	0	1	1	1	0	0	2
(WATTS + CURRENT) − (WATTS + CURRENT) DIFFERENTIAL DIRECTIONAL CURRENT	$(E\,I \cos\theta + I) - (E\,I' \cos\theta + I')$	IKP+IAC +IAC	CR3+CO +CO	1	0	1	1	1	1	4
	$(E_0 I_0 \cos\theta + I_0) - (E_0 I_0' \cos\theta + I_0')$	IBC	CRC	1	0	1	1	1	1	4
TOTAL										63

NOTES:
- #1 OVERCURRENT RELAYS ARE AVAILABLE IN NORMAL CURRENT RANGES AND LOW CURRENT RANGES AND ALSO IN LOW ENERGY TYPES FOR SPECIAL APPLICATIONS.
- #2 ALL RELAYS OF THE WATTMETER TYPE MAY BE SINGLE PHASE OR POLYPHASE EACH BEING PARTICULARLY ADAPTED TO CERTAIN APPLICATIONS.
- #3 DIFFERENTIAL RELAYS MAY OPERATE ON ELECTRICAL, MECHANICAL OR FLUX BALANCE PRINCIPLES.
- ⊖ POWER FACTOR ANGLE OF FAULT CURRENT IN THE LINE. THIS DOES NOT NECESSARILY INDICATE RELATION BETWEEN CURRENT AND VOLTAGE WITHIN THE RELAY.

Fig. 12—Factors which may be used for circuit protection

The first column lists those quantities or elements which are ordinarily used to control relays for circuit protection. Watt relays are used simply as a convenient means of determining direction of fault current flow and they do not ordinarily measure true power flow in the circuit, nor is it necessary that they should.

The symbols in the second column are those employed in most electrical calculations. The subscript 0 is used to denote a residual or zero sequence quantity. Letters without subscripts denote phase currents or voltages. $EI \cos\theta$ does not necessarily represent true power, but it indicates watts which are used to determine direction of current flow, with reference to direction assumed to be positive.

$\frac{E}{I}$ is a measure of apparent impedance and $\frac{E \sin\theta}{I}$ for reactance.

The last item $(EI \cos\theta + I) - (EI' \cos\theta + I')$ represents differentially connected directional overcurrent relays, the minus sign indicating that the difference of two currents, which are controlled as to direction, are measured by the relays.

The relay performance may also be controlled by the magnitude of the quantities which it measures and the kind of time delay. The time may be instantaneous, definite minimum, inverse or a combination of inverse and definite minimum. These characteristics are listed under qualifying factors.

3. Inadequate provisions for the necessary number of instrument transformers, switchboard space for relays and duct runs for control wires, etc.

It is distinctly not held that the protection should occupy prior or preferred consideration in laying out the system design, but that it should be co-ordinated. The different possible arrangements of major circuits should be compared not only with respect to their relative merits as to flexibility, economy and efficiency but also with regard to their adaptibility to circuit and apparatus protection.

When protection is found in the state that 1.5 to 2 seconds are required to clear faults from the generating station buses it is quite evident that either the best use

has not been made of the protective devices available or the major circuits are not arranged in such a manner that they can be used to best advantage.

It is emphasized that the protection on any part of the system cannot be determined entirely without regard to that on other parts of the system. For example, the protection of the feeders between generating stations is closely related to the protection on the generating station bus itself, generators and feeders connected thereto. If the full benefit of sensitive, selective, high-speed protection on the tie feeders is to be realized similar protection must ordinarily be provided on the other closely related circuits. It is therefore essential that the protection must be planned for the system as a whole.

Supplementary reactances offer valuable aid

If fault currents are to be maintained within reasonable limits the capacity on individual circuits must be limited in order to limit damage and minimize the disturbance to the system. The greatest concentration of power occurs, of course, on the generating station bus. The practice of tying bus sections through comparatively high impedances either by reactors, through system connections or by means of double winding generators is a step in the right direction. This principle should be extended to the remainder of the system.

If full provision for all protective equipment is not made when the system design is made it is usually a very expensive procedure to apply it when the need becomes acute. In fact, it may be so expensive that it is considered prohibitive, and it will be necessary to raise the entire level of switching times in order to maintain selectivity by means of graded time settings of overcurrent or directional overcurrent schemes. The net result is that abnormally long time settings will be required in order to clear faults, with the attendant hazard to system stability, possible communication of severe short circuits to other feeders and heavy sustained shocks to the system.

Study of the protection in conjunction with various proposed major circuit arrangements is not only desirable, but it is essential if the fullest benefit is to be realized. The advantages and disadvantages of the possible arrangements should be studied and their merits evaluated with respect to their importance relative to other factors. The place to start is in the planning and design stage, for in this manner the most efficient protection may be obtained at the minimum of expense.

▼ ▼ ▼

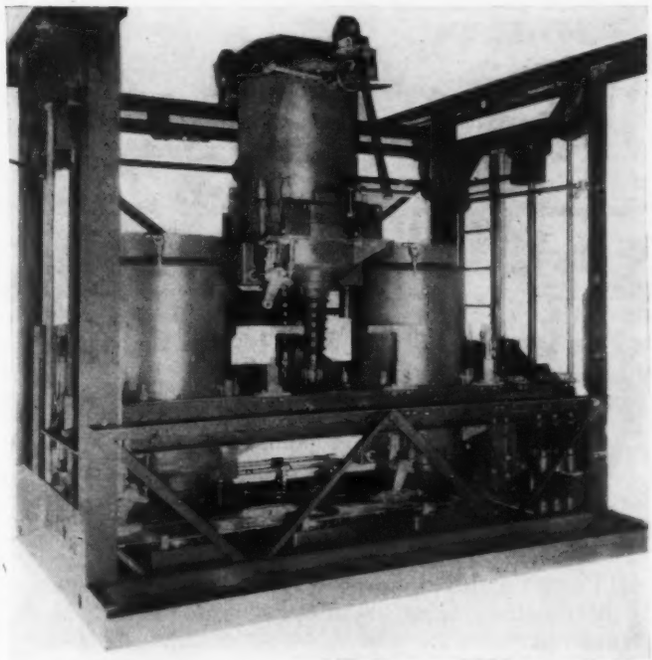
Unusual Switchgear for New York's New Subways

By L. W. BAILEY
Switchgear Department,
General Electric Company, Philadelphia, Pa.

High-voltage, metal-clad switchgear having some unusual features is now under construction for use in underground substations of the new subways for the Board of Transportation of the city of New York. Twenty-eight oil-filled units, fifteen of which are electrically operated, are being built, rated 37,000 volts, 600 amp. They will be used in connection with automatically controlled rectifiers.

Each unit consists of a single breaker with its potential transformers, current transformers, etc., and since each unit is isolated in a separate substation there is no bus. The cable is brought to a special pothead which effectively isolates the oil in the cable from the oil in the gear and allows the use of a proper expansion chamber. The gear is of the elevating plug-in type and, when the breaker is raised to the connected position and closed, connection is made through three current transformers to an outgoing cable pothead similar to the incoming line pothead, and thence to the outgoing cable. A positive action shutter isolates the contacts on the porcelain from the outside and is actuated by the raising or lowering of the breaker.

The normal removable unit of a metal-clad installation is the three-pole oil circuit breaker complete, but because of the location of this equipment in a subway a smaller removable unit was desired, and its design is such that any one of the single-pole units can be removed. The truck for this purpose is a special full ball-bearing, three-wheel unit in which the two rear wheels may be set

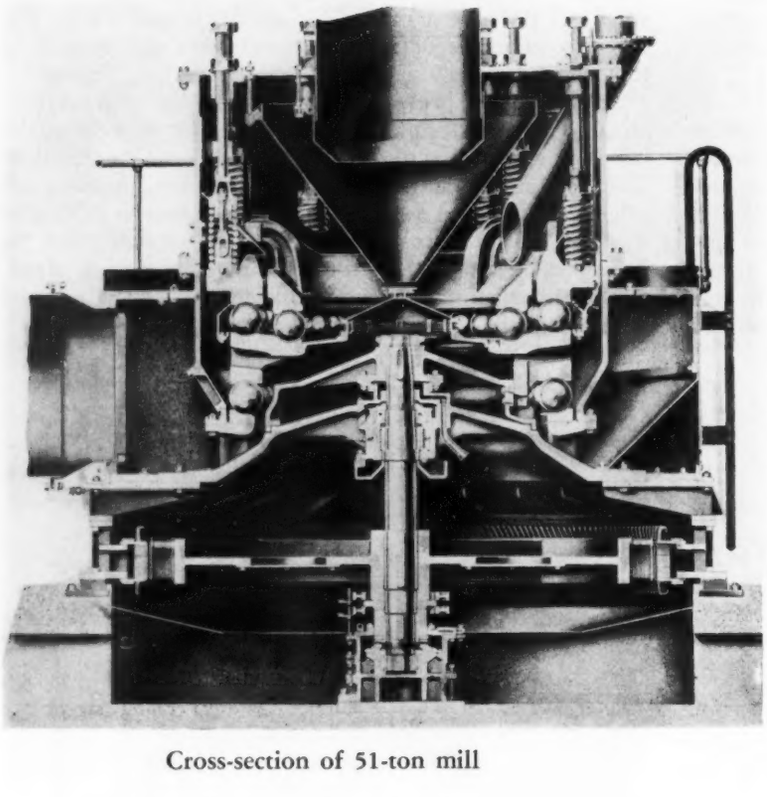


at any convenient angle to facilitate alignment of the removable unit.

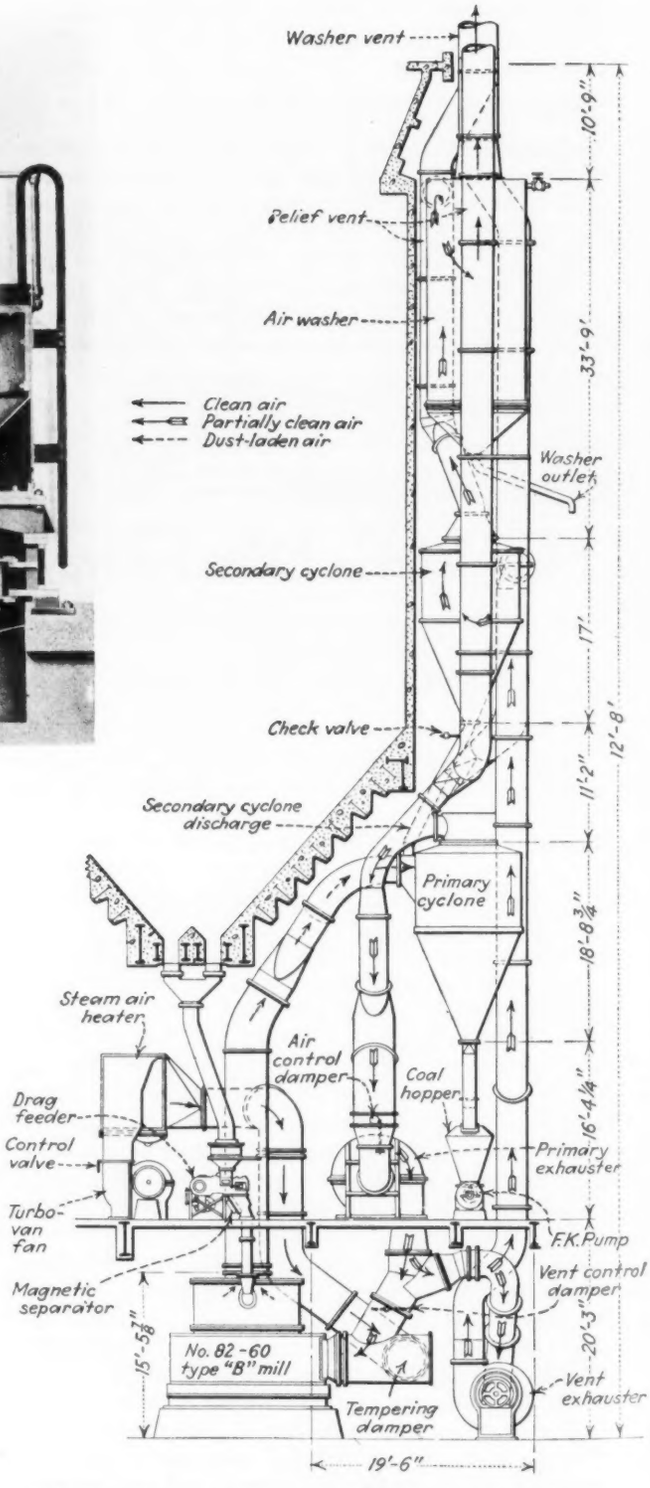
Interlocking is provided to prevent (a) lowering the breaker tanks when the breaker is in the connected position; (b) disconnecting the breaker when closed, and (c) automatic reclosing of the breaker after manual trip or automatic trip upon disconnecting the breaker. Provision is also made to padlock the shutters in the open or closed position and to padlock the elevating mechanism in any position desired.

The potential transformers are disconnected by raising the covers on the compartment in which they are housed. A complete system of "Alemite" lubrication is provided to minimize maintenance of mechanical parts.

Single Mill Pulverizes 54 Tons of Coal per Hour



Cross-section of 51-ton mill



Side elevation of 51-ton mill and related equipment

A PULVERIZING mill which on test turned out 54 tons of powdered coal per hour has been installed in the Kips Bay station of the New York Steam Corporation and has been in satisfactory operation for more than six months.

In explanation of the reason for adopting such a large mill, Perry Cassidy, Babcock & Wilcox Company, speaking before the Metropolitan section of the A.S.M.E., pointed out:

Rapid increase in demand for central-station steam made it necessary to install another steam-generating unit and additional pulverizing equipment. The increase in boiler capacity could barely be cared for by one new mill of approximately 25 tons capacity, but after this was installed only one bay would remain for future extension, while the building housing the boilers might be approximately doubled in size, to say nothing of the possibility of modifying some of the existing boilers to increase their steaming capacity. Space for two more 25-ton mills could be provided by building alterations, but these would not have given enough mill capacity for the ultimate boiler installation. Therefore a decision was made to purchase one mill of about 25 tons capacity to care for current demand and install in the remaining bay

Test Results on Two New Mills

	—Unit 6, 51-Ton Mill—			—Unit 7, 30-Ton Mill—		
	Expected Performance	Test	Results	Expected Performance	Test	Results
Grindability of coal	65	65	76	65	63	76
Mill capacity, tons per hour	40	44	54	25	28.8	30.6
Mill kw.-hr. per ton	9.5	10.3	9.5	10.0	7.8	7.35
Exhauster kw.-hr. per ton	5.0	3.6	2.9	4.5	3.0	2.7
Feeder kw.-hr. per ton	0.2	0.08	0.08	0.2	0.09	0.08
Total kw.-hr. per ton	14.7	13.98	12.48	14.7	10.89	10.13
Total air from mill, cu.ft. per minute	....	22,000	22,500	....	16,900	15,820
Total air from mill, cu.ft. per lb. coal	....	15.0	12.5	....	17.5	15.5

the largest mill meeting the requirements of system layout, operating reliability, low maintenance, low power consumption and uniformity of product. Existing building columns and floor elevations could not be changed and made it necessary to pulverize a considerably greater quantity of coal per square foot of floor area than was customary up to that time.

The largest mill finally selected was nominally rated at 51 tons and is the first type B mill to be supplied with a third inner row of grinding balls. This third row of balls has an independent upper grinding ring, spider and spring system. Coal from the feed spout drops onto the rotating table attached to the intermediate grinding ring. The centrifugal action of the table throws the coal into the inner row of balls, where the first stage of pulverization takes place. From the inner row of balls the coal passes to the outer row, where the second stage of pulverization is effected. Coal is retained in this outer row by the perforated annular basket outside the intermediate and top grinding ring. Tramp iron which may escape the magnet is retained in this basket until removed periodically.

When the coal is reduced fine enough to pass the adjustable ledge gap between the intermediate grinding ring and the basket it falls to the space outside the lower row of balls and thence into the third stage of pulverization. Hot primary air passes through the ports beneath the lower grinding ring and upwardly past the inside of the lower row of balls, where it picks up the pulverized coal discharged from the third stage. Most of this coal and air pass outwardly through ports in the intermediate grinding ring; the remainder, by passing through the cylindrical screen, is directed against the inner row of balls, where the hot air mixes with the raw coal from the feed spouts. The coal and air leaving the ports in the intermediate grinding ring pass upward around the perforated coal basket. Some of the hot air passes through the perforations in the top of the coal basket between the outer row of balls and up into the top section. The main stream of coal and air is deflected by a sloping conical baffle and is directed downward toward the center of the mill. The three streams of coal and air unite and pass over and into the conical separator and out the top of the mill.

Expected performance excelled

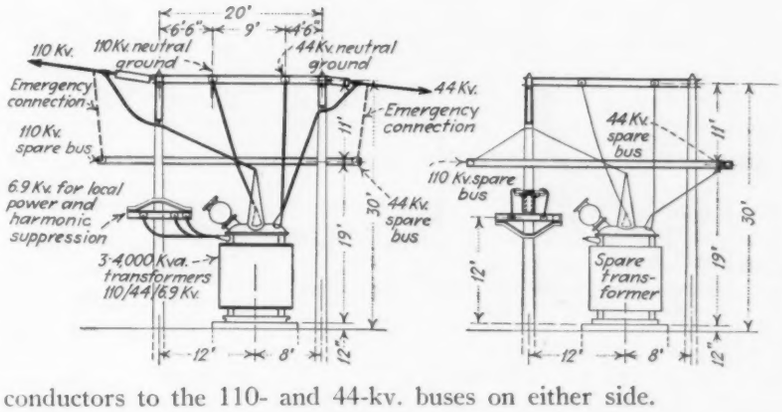
The expected performance for this mill and the smaller one installed (units 6 and 7) was based upon pulverizing Pittsburgh coal, crushed to pass through a $\frac{3}{4}$-in. ring, moisture to be not over 6 per cent, with coal having a grindability of 65 or better, provided that preheated air at 400 deg. F. is available for use in the mill. The expected performance of mill No. 6 was 40 tons per hour with a fineness of 70 per cent through the 200 mesh and 98 per cent through the 40 mesh. The expected power consumption was 9.5 kw.-hr. per ton for the mill, 5.0 kw.-hr. per ton for the exhauster and 0.2 kw.-hr. per ton for the feeders, or a total of 14.7 kw.-hr. per ton. Under the same conditions the expected performance for mill No. 7 was 25 tons per hour with a power consumption of 10.0 kw.-hr. per ton for the mill, 4.5 kw.-hr. per ton for the exhauster and 0.2 kw.-hr. per ton for the feeders, or a total of 14.7 kw.-hr. per ton. The expected maintenance material cost of both mills is not over 2 cents per ton.

A large number of tests were run on both mills for experimental data prior to the acceptance tests. The acceptance tests demonstrated conclusively that both mills met all requirements with an ample margin. The results of two of the tests on each mill are given in the accompanying table for low- and high-grindability coal. In all of these tests the fineness of the pulverized coal complied with the specification of 70 per cent through the 200 mesh and 98 per cent through the 40 mesh.

▼ ▼ ▼

Easy Changeover to Spare Transformer

Operating simplicity in an installation entirely devoid of frills but yet perfectly adequate is the distinct feature of the 110/44-kva. transformer bank in the Wausau substation of the Wisconsin Valley Electric Company. The structure consists of six wood poles with steel crossarms and no structural members between bents. Except for the 6.9-kv. connection, there are only four cross buses. Two are the primary and secondary grounded neutrals at the top and the others are the spare buses at the sides. As shown by the drawing, putting the spare transformer into service requires simply the dropping of jumpers from the affected phase conductors to the 110- and 44-kv. buses on either side.



Electric Construction Index

Electric light and power construction costs are nearer the 1913 level than they have been at any time since 1917; the average has declined 22 per cent since the beginning of 1930 and now stands at 65 per cent of the post-war peak, but it is still 42 per cent higher than in the pre-war base year, 1913.

The accompanying index, compiled by Prof. Albert S. Richey of Worcester Polytechnic Institute, shows the changes by months during a period of eighteen years. It is an average of currently available indices relating to component parts of electric light and power consumption costs, so selected and weighted that the resultant index very closely matches the average experience in the actual variation of these construction costs over a period of some fifteen years, including the marked fluctuations in the years 1915-1923, inclusive.

These costs, which were used for the "pattern" index, were taken partly from the author's own experience and partly from data which were kindly supplied by three large engineering organizations, each of which had given special attention to this matter during the period covered. The resultant index is presented under the assumption that if it fits the cost trends in the past it will continue to so fit for a reasonable time in the future. The validity of such an assumption apparently has been borne out by experience with the A.E.R.A. electric railway construction cost index, which was developed in 1924 in a similar manner.

In the chart three construction indices are compared: Electric light and power, electric railway (A.E.R.A.), and general (*Engineering News-Record*).

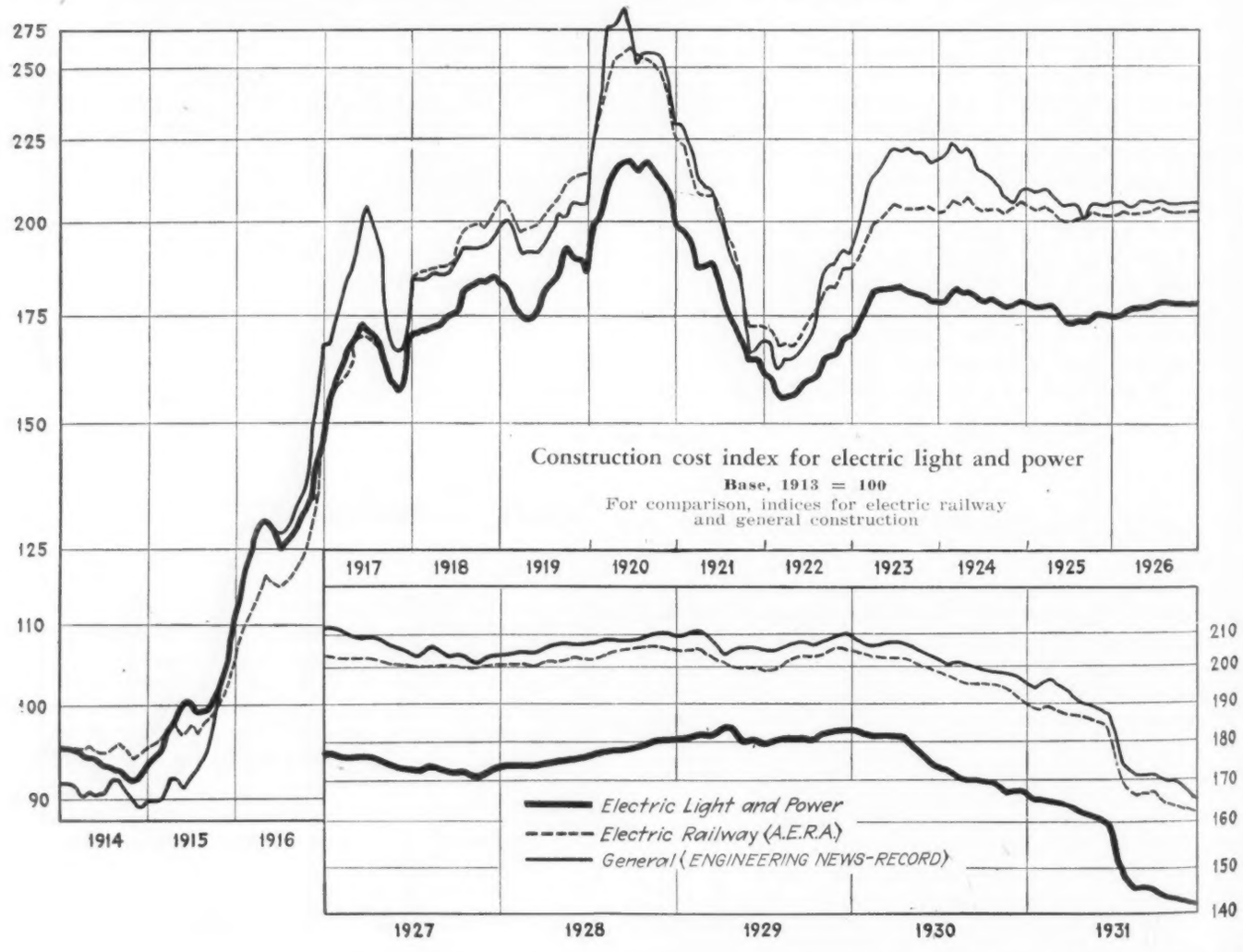
Electric Light and Power Construction Cost Index*

Base, 1913 = 100

	1914	1915	1916	1917	1918	1919	1920	1921	1922
January	94	92	114	148	171	184	187	199	162
February	94	93	120	156	172	180	197	199	160
March	94	94	124	163	172	177	204	194	155
April	94	97	129	166	172	174	212	187	156
May	93	99	131	168	172	174	216	188	156
June	92	100	128	172	175	176	218	189	158
July	92	101	125	172	176	181	219	183	159
August	91	99	127	171	182	183	216	176	161
September	91	99	128	166	183	186	219	173	164
October	90	100	130	159	183	193	216	170	166
November	90	103	136	157	184	190	212	164	165
December	91	107	142	159	186	189	209	164	169
Average	92	99	128	163	177	182	211	182	161

	1923	1924	1925	1926	1927	1928	1929	1930	1931
January	170	178	180	175	177	174	181	183	165
February	173	179	178	175	176	174	182	182	165
March	178	182	178	176	176	174	182	182	164
April	182	181	176	175	176	175	184	182	163
May	182	182	176	176	174	175	179	177	162
June	182	180	174	175	174	176	179	175	160
July	183	179	174	176	173	176	178	173	148
August	182	179	174	178	174	177	179	171	146
September	182	179	174	178	173	177	181	170	146
October	180	178	175	178	173	178	181	169	144
November	180	178	176	178	172	180	183	168	143
December	179	180	175	177	174	180	183	168	142
Average	179	180	176	176	174	176	181	175	154

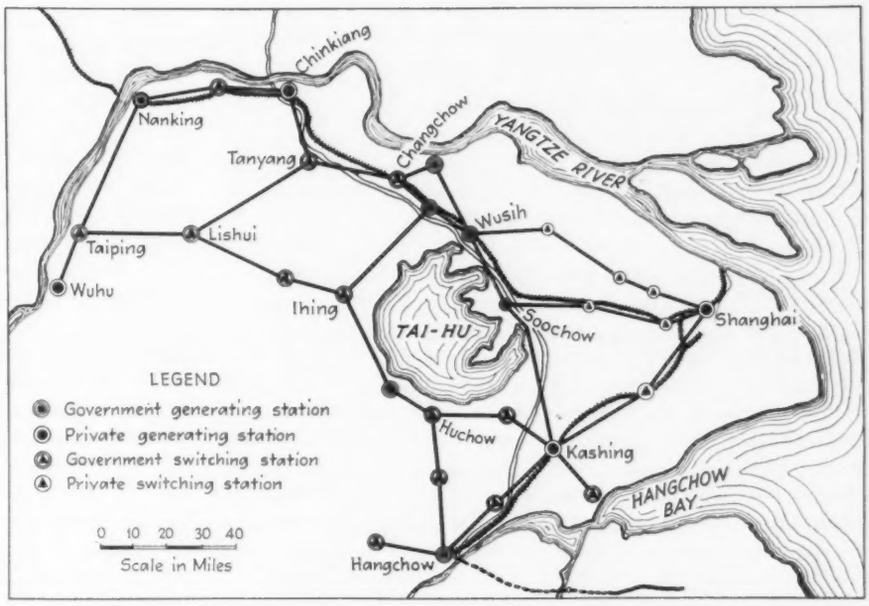
*By Albert S. Richey.



Developments in Chinese Electrical Industry

By TSUNG HAN CHEN
Cornell University

FIVE hundred per cent increase in the past decade has recently been reported in the consumption of electricity for all purposes in China. This is no surprise when one becomes aware of the fact that electrical service is now available in every large city and the majority of small towns throughout the country, especially in the southeastern provinces. The price of electricity is so reasonably low as to be within the reach of the people of all classes. A family using more than three lamps has found that it is more economical to use electric lights rather than kerosene or gas lamps.



Proposed electrification of the Yangtse area

To-day there are in China more than seven hundred electric power plants, totaling about 850,000 kw. in capacity. Of these 575 are supplying electricity for power and lighting to the communities. There is at least one electric plant which has been for several years supplying electrical energy for the irrigation of thousands of acres of land. Industrial factories requiring large amounts of power usually have electrical generating plants of their own, and those industrial power plants situated in isolated localities also provide electrical service for their employees or the neighboring towns or villages.

Fifty-seven per cent of the motive power for generating electricity in the country is derived from steam, 36 per cent from crude oil, 6 per cent from producer gas and less than 1 per cent from waterfalls. The small units in many small plants have made it desirable to use crude oil or producer gas, although one plant having a capacity of more than 10,000 kw. is equipped with Diesel engines. The meager amount of water power developed is due partly to the sources of water power being remote from load centers and partly to the scarcity of waterfalls.

Transferring supervision to technically trained men

Years ago the engineering part of a Chinese utility or industrial electric plant was in most cases played by a foreman or head mechanic. However, there has long been a tendency to place power plants under the supervision of technically trained engineers. Today there are in China more than a sufficient number of young Chinese engineers trained in domestic engineering colleges or returning from abroad to meet the demands of electrical power plants. The improvements in coal consumption, labor cost, etc., brought about by the efforts of such an engineer have been so marked that no plant owner will any longer doubt the wisdom of employing in his plant a technically trained man.

One industrial power plant which has been since the laying down of its foundation under the charge of a Chinese engineer has had a coal consumption of less than 2 lb. per kilowatt-hour ever since 1922, in spite of its having merely two 1,000-kw. units. In the case of another utility the transfer of the authority from an old management to a modern engineer has in a few months' time resulted in a reduction in fuel cost from 1.83 cents to 1.46 cents (Chinese currency) per kilowatt-hour generated and a decrease of electrical distribution and other losses from 60 to 38 per cent of the total generating energy.

Realization of the necessity of employing technical men on the part of plant owners has even gone a step further. The feeling is now prevailing that not only the engineering end but the administrative functions should also be intrusted to specially trained college graduates. A modern accounting system for the utility business has been introduced to an increasing degree during recent years and considerable importance has been

Twenty-Year Forecast of Chinese Electrical Industry

Division	Generating Capacity — Total Kw.	Generating Capacity — Estimated Cost*	Transmission Lines Total Km.	Transmission Lines Estimated Cost*
Lower Yangtse area., including Kiangsu, Chekiang and Anhwei	1,226,000	$613,000,000	2,420	$29,040,000
Southeast division, including Kwangtung, Fukien and Kiangse	455,000	227,500,000	3,760	45,100,200
Southwest division, including Hunan, Kweichow, Kwangsi and Yunan	400,000	200,000,000	6,920	83,040,000
Western division including Tsinghai, Kansu, Szechuan, Hupeh, Shensi and Shansi	1,053,000	573,500,000	7,640	100,300,000
Lower Huang Ho area, including Hopei, Honan and Shantung	1,038,000	519,000,000	4,490	53,880,000
Northern area, including Kirin, Liaoning, Heilungkiang, Jehol, Charhar, Suiyuen, Ninhsia, Sinkiang and Mongolia	900,000	450,000,000	4,660	55,920,000
Total	5,072,000	$2,583,000,000	29,890	$367,280,000

*Cost in Chinese currency.

attached to rate-making for the mutual benefit of both the consumers and the utility industry. Last, but not least, the modern methods of management applied to old plants have almost invariably resulted in expansion of sales and increase of income, coincident with reduction of rates.

In spite of its rapid growth, the electrical service in China is still far from being adequate, taking the country as a whole. With a view to laying down a definite program for electrifying the whole of China, the National Construction Commission of Nanking Nationalist Government has completed an extensive survey of future power demands and formed a new project for the development of the electrical industry. According to the schedule of this project, the development work will be divided into six divisions and carried out in four periods of five years each. The total generating capacity, the length of main transmission lines and their respective estimated costs for each division at the end of the fourth period are shown in the accompanying table.

Opinions have been expressed by experts that the figures in this forecast do not appear unreasonable. History has shown that the electrical industry in the United States has been doubling in volume, on the average, once in six to seven years. It is to be noted that the growth of generating capacity from the present figure of 850,000 kw. to 5,072,000 kw. in the course of twenty years, according to the projected expansion, means an increase at a rate of 100 per cent every eight years.

Chinese engaging more in electric manufacturing

China imports a large portion of the electrical equipment it uses. Between 1924 and 1928 the trade in electrical supplies from abroad increased from 9,000,000 to 12,600,000 Haikwan taels (approximately $5,500,000 to $8,000,000). But during the last decade many a factory has sprung up like a mushroom to manufacture various electrical apparatus and materials. Today there are on the market Chinese-made motors, transformers, batteries, electrical fans, oil switches, insulators, lighting fixtures and what not. Most of these factories are run by returned students. Other young Chinese engineers have been organized to take up the contracting and consulting business.

The Chinese Government Electric Works may be worthy of special mention. It has an existing plant at Nantao, Shanghai, which is now engaged in the manufacture of radio equipment and small apparatus. There has been planned a new project with a capital of $10,000,000 for building electrical machinery and accessories. An incandescent bulb plant is also being contemplated with an estimated outlay of $500,000.

New light has recently been thrown on the electric manufacturing industry by an announcement, made in the annual convention of the electrical association, to the effect that the whole electric power and light industry is ready to give its co-operation in the organization of a large-scale manufacturing plant for electrical apparatus.

Electrical association active

In July, 1929, there was founded the Association of Chinese Public Utility Corps. It included only privately owned electric power and light companies, electric traction companies and telephone companies, prior to its third annual convention held in Nanking last November, when it was announced that its membership would be extended to electrical manufacturers, dealers, government officials and any individuals who are connected with the electrical industry. The majority of its members are from the electric light and power companies, which represent more than three-quarters of the Chinese-owned electrical industrial in terms of kilowatt capacity. More than ten branch associations have been established in different provinces.

The association plays an important rôle both in the promotion of co-operation between the government regulatory bodies and the privately owned electric companies and in the advancement of the art of the electrical engineering for public service. It became a member of the Union Internationale Producteurs et Distributeurs d'Energie Electrique in 1930. It sent representatives to the World Power Conference held at Berlin in May, 1930, and to the last annual convention of the National Electric Light Association in June, 1931.

Among other features of the electric association's last convention were the founding of a statistical department for recording the progress of the industry, a committee for educating the employees of the member companies by correspondance and a special committee to negotiate the establishment of an enterprise for manufacturing electrical supplies and equipment.

About one-third of the whole electrical industry in China is owned by foreigners at present. The most conspicuous foreign electric enterprise is the Riverside power station at Shanghai, formerly owned by the municipality of the International Settlement and sold to the Shanghai Power Company in April, 1929, at a price of 81,000,000 taels (approximately $50,000,000). The generating capacity of this station alone represents about 20 per cent of that in the whole country. The Shanghai Power Company is controlled by the American & Foreign Power Company. By reason of the low rates of exchange now prevailing foreign properties can be acquired at advantageous prices and the higher prevailing rates for service afford opportunities for a larger return on invested capital than is obtainable from similar enterprises in the United States.

The Riverside transaction was watched with great concern by the Chinese people, particularly those connected with the electrical industry. The intenseness of this concern was attested by a later incident connected with the mortgage of the Hangchow Electric Company in Chekiang. Public suspicion that foreign investment

might have been involved in the mortgage was sufficient to cause the National Construction Commission to withhold the permit for the said company. This does not mean, however, that the Chinese people are opposed to foreign investment altogether. On the contrary, according to one of the spokesmen in the electrical association, foreign capital invested under terms affording mutual benefits to both parties will be heartily welcomed.

Recently the Chinese electric enterprises in Manchuria have been hard hit by the Japanese invasion. Some power plants have been seized and closed by force. Yet hope is entertained that the losses should be eventually recovered, if the Chinese should survive in Manchuria.

Future prospects

Development of the electrical power industry in any nation depends on the sources of power it possesses. China has abundance of coal, but little of oil. It is only natural that steam power should be emphasized in the generation of electrical energy.

The upper Yangtse River has a considerable fall near the boundry line between Szechuan and Hupeh, and hundreds of thousands of horsepower may be harnessed to generate electrical energy. But it will take some time before its development can be actually carried out. First, the railway or other land transportation systems must be sufficiently developed around this area to make unnecessary the use of the river for navigation purposes. Secondly, the magnitude of such an enterprise will be such that the nearby market should be able to absorb enough of the tremendous amount of power available to make the project financially attractive. There are also possibilities for water-power development in many other parts of the country.

The future of the Chinese electrical industry appears particularly promising on account of the electrical interests being well organized. Its expansion will give an impetus to the growth of other industries, and the latter will in turn augment the use of electrical energy. These effects will multiply themselves.

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Remotely Operated Pipe Line Pumping Station

By M. E. REAGAN

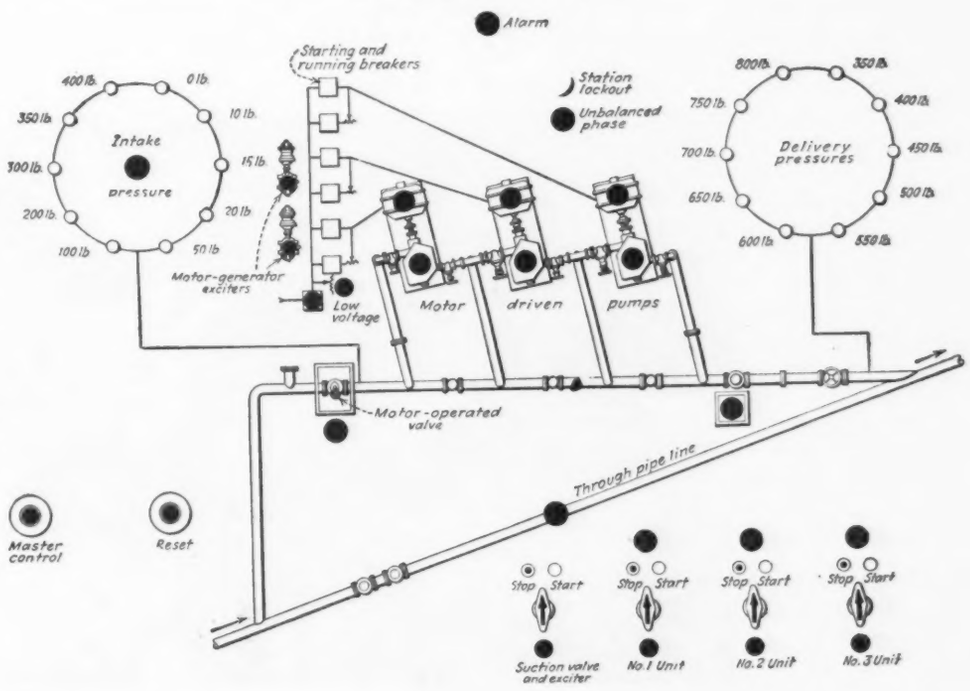
Switchboard Engineer
Westinghouse Electric & Manufacturing Company

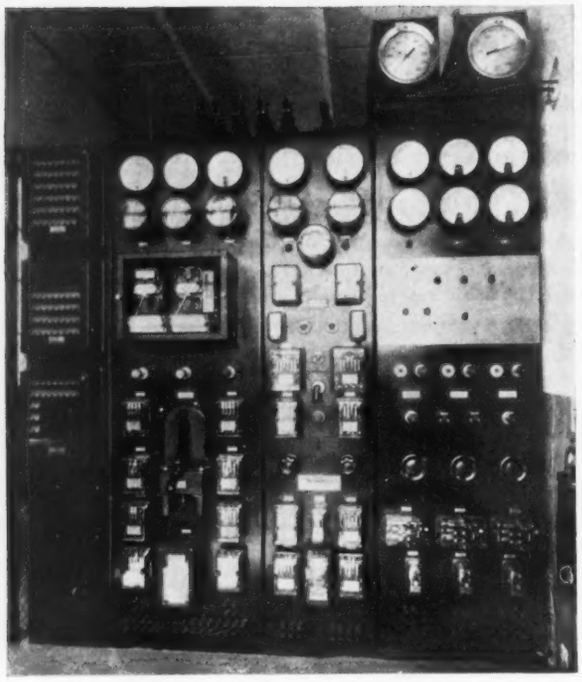
A DISPATCHER in an office building in Tulsa, Okla., operates the Sand Springs pumping station, 15 miles away—the first supervisory controlled pipe line pumping station. He is linked with the station by only two line wires and impulses traveling over these wires control the fuctioning of the three 800-hp. synchronous motor-driven pumps at the station. The system employed is known as "Visicode" supervisory control and its recent application for the remote supervision of a pumping station represents the first step toward attaining complete remote control of all the booster stations located on a pipe line system so that the entire line may be operated as a unit.

Before the dispatcher in Tulsa is a control board consisting of an etched plate simulating the actual layout of

Remote-control board simulates pumping station layout

When the dispatcher wishes to start the first pump he throws the arrow-shaped control to the right or start position and presses the push button immediately below. Impulses select the control relays for the motor-operated valve and return the indication which lights the upper right-hand lamp of the assembly. He then presses the master control button (lower left) and the valve opens. Indication that the valve has opened comes through and causes the lamp (circle just below the motor-operated valve) to burn. The exciter starts automatically after the valve is open and sends in its indication in the form of a light in the small motor designation. The Tulsa operator then goes through the same sequences of operation with the control key assembly of one of the three pumps. As the pump comes up to speed, the lights located in the center of the motor designation burn and the lights of the two pressure gages change to their new values.



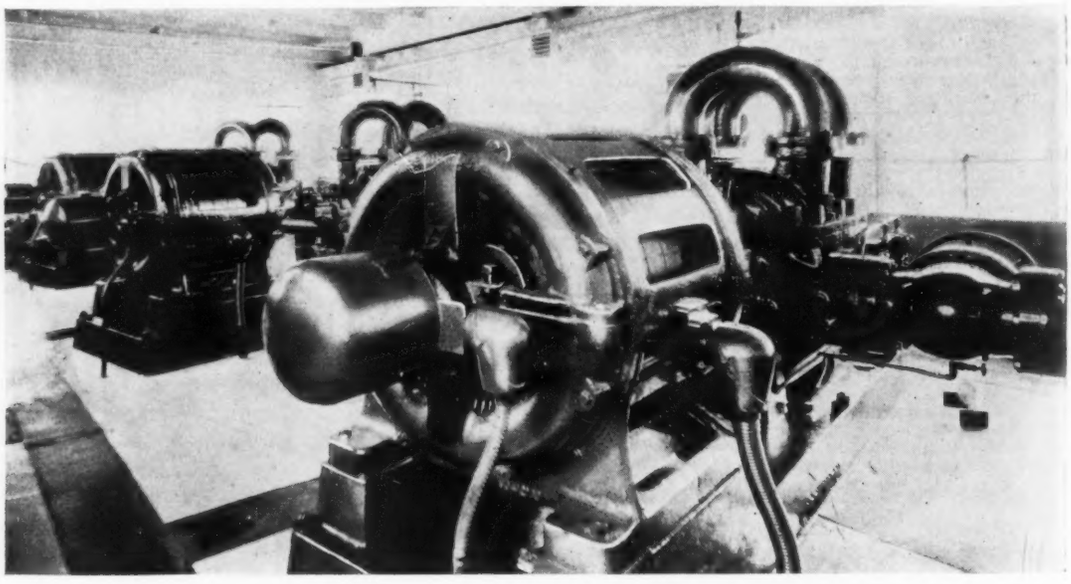


Relays replace an operator

the station. The station itself is divided into two main rooms, the larger of which contains the three motor-driven pumps, a sump pump and protective equipment guarding against fire and overheated bearings, and the smaller houses the main automatic switching equipment with protective relays, the motor-generator sets for the excitation of the synchronous motors driving the pumps, pressure gages and the supervisory control equipment. Outside the main building of the station is a large motor-operated valve that opens before the station starts and closes after the pumps are taken out of service. By means of miniature lamps on the board the operator is informed of the conditions at the station; he sees the number of pumps in operation, the position of switching and protective apparatus and the values of suction and discharge pressures, and, if any pump is taken out of service due to trouble, he is immediately notified and also informed of the cause of the interruption.

When the Tulsa operator wishes to place the station in operation he turns the control key associated with the particular pump which he desires to start to the "start" position. Then, by pressing a button, he sends to Sand Springs a certain code signal, upon the receipt of which that station sends the same signal back to Tulsa, causing a signal lamp to light and insuring that the pump selected will be the one that starts. Seeing that the proper check lamp is lighted, the dispatcher presses the "master operate" button, which sends to Sand Springs a code of a predetermined number of impulses to start the pump. The operator having performed these few simple operations, the automatic sequence of operations for starting is inaugurated at the station. When the starting impulses are received the motor-operated valve opens (if no units of the station are already in operation), connecting the station to the pipe line; the motor-generator set for the excitation of the motor is started and the pump is brought up to synchronous speed. As the pressure changes due to the functioning of the pump, the readings of the pressure gages are sent to Tulsa and indicated on the control board. To transmit the pressures motor-operated pressure gages follow a standard pressure gage and make contacts, which, in turn, send impulses to Tulsa, which control lamps on the dispatcher's board.

The protective devices at the station guard against low voltage, reverse phase, phase balance, overheating of bearings, overheating of motors, and fire. The Sand Springs station need not necessarily be remotely controlled, for a control board is located at the station for local control. Part of the 15 miles of double line wire, over which all operating impulses and indications travel, is through telephone cable, the other portion being open wire. Using electric drive for pipe line pumping makes possible the operation of an entire line as one unit rather than as a series of sections, and such drive effects lower first cost, better space factor, lower operating costs and lower maintenance than other drives; the use of supervisory control for electric drives for pipe lines effects further economy by providing attendantless and accurate operation.



Pipe line pumps controlled from 15 miles away

Standardizing Practices of Merged Companies

An Interview with

M. S. SLOAN*

WHEN the Brooklyn Edison Company, New York Edison Company, the United Electric Light & Power Company and New York & Queens Electric Light & Power Company were merged into the New York Edison System in 1928 a variety of engineering and operating practices existed which if allowed to continue would have hampered securing the benefits that can be derived from an integrated, unified system. Despite this situation and the natural antipathy of any individuals to conform to standard practice, great strides have been made in eliminating diversity of practice, as evidenced by the number of engineering and operating practices which have been standardized.

Inasmuch as these standards have been developed by co-operative action of individuals in the component companies and not by autocratic pronouncement, the accomplishment is a credit to the individuals who compromised and to the executive head who initiated and actively participated in harmonizing the practices. But, more than that, the results obtained and the procedure adopted may show other companies how they may unify practices with the least friction.

To ascertain the elements which made this standardization program so effective, M. S. Sloan, president of the New York Edison System at the time this information was secured, was asked to explain the situation which initially existed, the mechanism which he established to correct conditions, the policy followed and some of the achievements. Following is what he said:

Conditions that prompted action

"In September, 1928, when I became president of all the electric companies in the Consolidated Gas utility group, the four chief constituents—the New York Edison Company, Brooklyn Edison Company, Inc., the United Electric Light & Power Company and the New York & Queens Electric Light & Power Company—had diverse engineering policies and practices, and in many other phases of the business their practices also differed widely. The fifth company, the Yonkers Electric Light & Power Company, followed in general the policies and practices of the New York Edison Company, by which it had been owned for many years.

"The power plants of the New York Edison Company developed 25-cycle current. The plants of the Brooklyn Edison Company and the United Electric Light & Power Company developed 60-cycle current, but the Brooklyn Edison plants produced it at 26,400 volts, while the United plants produced it at 13,200 volts.

"The New York Edison Company had a three-wire direct-current distribution system in Manhattan and four-wire, two-phase alternating-current system in the Bronx. The United company, supplying alternating current in Manhattan, had a three-phase, four-wire lighting system and a separate three-wire power system in process of changing to three phase, four wires. Brooklyn, which had almost eliminated direct current, had a three-wire, single-phase lighting distribution system and a three-wire delta power system, but was extentively progressing the installation of a three-phase, four-wire alternating-current network for light and power. The Queens company, supplying alternating current, had primarily a three-wire, single-phase lighting system and a three-wire, delta power system, but in small sections of the territory there was a three-phase, four-wire network for light and power.

"Basic considerations of economy and efficiency dictated a standardization of policies and practices—first, as to engineering; second, as to other branches of the business. For many months now such standardization has been in effect with only minor variations, due to differing conditions in local territories. When it becomes possible actually to merge these companies it will be a simple job because now they are operating in harmony.

"Perhaps this would not have come about so quickly if we had not faced at the very beginning of my term of office a problem which required immediate action. The Board of Transportation of the city of New York was building new subways. The question of a power supply was up. Our four system companies must furnish this power or the Board of Transportation itself must supply it. If the system companies furnished the power, the type of service and method of rendering it must be uniform in all their territories, and the four

*President of the New York Edison System at the time of interview.

companies had four varying practices and four plans for future development. It became necessary, therefore, in order to submit bids, to establish a standard, and this standard must obviously be in line with the most progressive development of the electrical art.

"Now the engineer has at least a bowing acqaintance with pure science. He is and must be a delver after facts. He is no good as an engineer if he can't build a logical conclusion on a given set of facts correctly ascertained. Most of the differences in the engineering practices of our companies were the result of divergent fundamental assumptions. One group was working on a hand-to-mouth development, so to speak; another was planning for the most economical development over a long period of years. It has long been my conviction that if a group of engineers dig out all facts available in a specific situation, and project these facts into the future ten or fifteen years, when the load will be three or four times its present size, thereby minimizing prejudicial effects of present commitments, it will be possible for them to arrive at a common understanding.

Co-ordination put up to committee

"My first step in the necessary standardization of practices was to establish a committee of the responsible electrical engineers of the four companies. I instructed these men to collect all available facts and project plans into the future on several alternative schemes of development. I told them I wanted a plan which would yield the greatest mutual advantage to customers and companies, and particularly would make it possible for the system companies to submit a bid to the Board of Transportation at the most favorable prices and flexible conditions, having in mind our system as it would probably develop and tie in with other systems within the next decade.

"This committee collected the facts and then submitted recommendations—with vast labor, but, as I had believed possible, without any serious difficulty in reaching a conclusion. The recommendations showed that the trend of system development required the supplying of 60-cycle service for the new subways (although all existing traction load in this territory was furnished at 25 cycles), in order that the greatest advantage might be taken of the diversity between the traction load and the general power and light load. A bid was submitted and accepted on that basis. This decision was made three years ago and subsequent developments, both from the standpoint of the Board of Transportation and from that of our system companies, have more than realized the predicted advantages.

"In October, 1928, I set up this committee on a formal basis. I appointed a technical advisory committee, composed of the responsible engineers, operating superintendents and executives, to advise me on all technical matters relating to the development and operation of the plants in the affiliated companies, so that a consolidation of facilities might be brought about primarily to yield the greatest benefits to our customers. Within this top committee were organized an electrical standing committee and a mechanical standing committee, with authorization to form necessary working committees and sub-committees.

"To the technical advisory committee was assigned the task of reviewing the character and type of service supplied to our customers, which had varied over wide limits, and submitting recommendations for universal type of service, so far as this was possible considering the physical conditions existing in the territory of the different companies. The committee was also instructed to report on the most desirable method of operating the system in order that all companies might have the benefit of the most economical use of the generating equipment, making it possible to shut down less efficient plants when not actually required to carry load. It was recognized that this would require additional transmission lines to make power from the most efficient stations available to all parts of the companies' territory. Through this committee the combined ability of our best men has been available in considering problems of installation of new generating equipment and new transmission and distribution facilities to meet increased load requirements.

Reorganization of purchasing

"This committee undertook also a reorganization of the methods of purchase and handling of materials. It has prepared standardized specifications for all the materials purchased in large quantities and has submitted recommendations regarding the most economical method of operating the storerooms so that stock located at any point in the system might be made available for the entire system. Standardization of materials and methods of construction has proved effective in permitting the transfer of personnel, particularly skilled labor, from one company to another and has been a big element in making it possible to provide work for these men during the trying period of the last two years.

"In the little more than three years during which the technical advisory committee has been functioning 486 recommendations have been prepared and approved by it. These have, by executive order, been made effective in all of the companies. With very few exceptions, these recommendations have been submitted to the technical advisory committee with the unanimous indorsement of the standing committees. In the few cases where there was a difference of opinion in the standing committees the individuals representing the divergent viewpoints had full opportunity to present them before executive decision was reached. There have been approved 113 standard specifications for materials, which, wherever possible, have been made to conform with national specifications as they are available. The adoption of standard specifications has resulted in a large increase of use of standard materials, with corresponding savings and with increase in safety to employees. Even specifications for tool handles, pike poles and ladders have been approved in order to assure the purchase of high-quality articles, so reducing to a minimum the possibility of breakage and injury to workers.

"What has been accomplished in this respect is indicated by one example: Prior to standardization 500 sizes and types of cables were being purchased for stock by the system companies. These have been reduced to 138 standard sizes and types, and further reduction is under consideration. On one year's purchases alone savings in the first cost of cable of approximately $725,000 have been realized.

"In the combined operation of generating stations an economy committee has been set up, reporting to the technical advisory committee through one of its stand-

ing committees. This economy committee prepares a schedule of operation with loading on the various units indicated for each day's production, taking into consideration continuity of service, stand-by capacity, the units available, tie feeder capacity and the load on the system at various times of day. This schedule is prepared for the system as a whole, placing the load at the point of greatest economy regardless of company or individual station. Actual operation is checked daily with this schedule of operation, and there has been extremely close agreement between the schedules thus prepared and the actual loads carried by the generating plants. Comparing operating conditions for 1929 and for 1930—that is, conditions before and after such centralized control—our figures show that a reduction in production costs amounting to $750,000 was realized in spite of an increase in output of more than three hundred million kilowatt-hours. This would indicate a saving of $2,250,000 on the basis of the same output. That was 9 per cent saving in production cost, and of this 9 per cent two-thirds was due to thermal savings by the operation of the more efficient generating units for a greater length of time.

Ten-year plan adopted

"One of the most important accomplishments of this committee's work has been the establishment of a ten-year plan for development of our distribution systems so that all changes might be made in accordance with a definite development scheme. This plan provided for the extension of the three-phase, four-wire, 60-cycle, 120/208-volt network system, with lines placed underground as rapidly as the expenditures could be financed on the basis of companies' earnings and load growth. For more than two years we have had a depression. Nevertheless, 60-cycle alternating-current service has been made available throughout the system territory and this standard alternating-current network system has been provided for all of Manhattan Island, paralleling the existing direct-current system and supplanting it in portions of the territory. In 1931 the 60-cycle load growth in Manhattan amounted to 40,000 kw., or 40 per cent, with a reduction of load on the direct-current system of 37,000 kw. Changeover to alternating current in Brooklyn has progressed to a point where only 15,000 customers, requiring 22,000 kw. of load, remain on the direct-current lines. Last year's growth amounted to 4,600 kw., or 1.4 per cent, on the alternating-current system, with a decrease of 6,600 kw., or 23 per cent, on the direct-current lines.

"During 1930 $42,000,000 was expended in additions and changes to the distribution system of the group of companies, of which 85 per cent was spent according to this ten-year development plan for the three-phase, four-wire network.

Similar co-ordination in other branches

"In other branches of the business I have set up advisory committees which function like the technical advisory committee. The accounting advisory committee has jurisdiction over our general accounting practices and those for consumers' accounts also. The commercial advisory committee studies the sales and business promotion side of the business and advises me in relation to it. The rate advisory committee studies and analyzes constantly our rates in order to standardize them on a real inducement basis. Whenever these committees have problems of mutual interest—which is naturally often—they hold joint meetings and produce recommendations to me in a combined report.

"These advisory committees serve as clearing houses between our companies and national committees of the engineering societies and utility associations. This enables our companies to convey to the national organizations the greatest benefit of our operations and experience and permits our companies, in return, to receive the greatest benefit for the time and efforts expended by our representatives in such national committee activities. Periodic reports are submitted to me regarding such committee work after it has been analyzed by the respective advisory committees.

"So that information will always be available showing the basis on which we have worked, executive orders approving the recommendations of the technical advisory committee, together with supporting data, have been bound for permanent reference."

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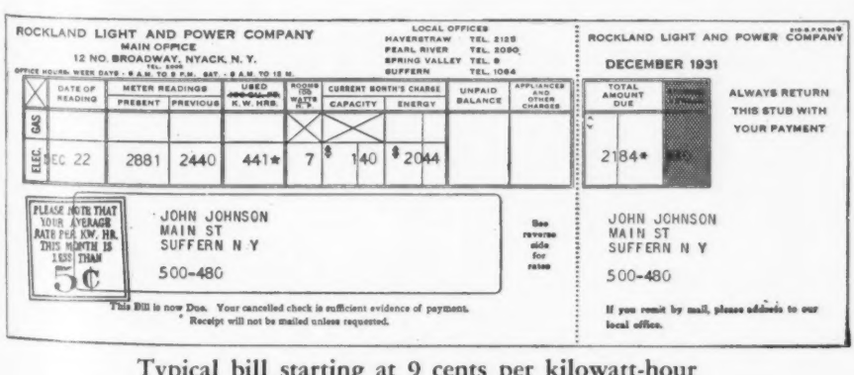
Bill Stamp Emphasizes Low-Priced Service

Favorable popular reaction has been received by the Rockland Light & Power Company, Nyack, N. Y., from the practice of stamping the bills of substantial users of residential electric service with the average rate per kilowatt-hour earned per month by the customer's installation. About 25 per cent of the household customers of this company received stamped bills for their December usage. Several stamps have been provided for lower average rates, and it is believed that as more and more customers realize their low average earned rates they will make much freer use of service. Expressions to this effect are coming to light in connection with the payment of bills. Many customers who never stopped to figure their average rate are now being made "low-rate conscious" by the simple method utilized.


ROCKLAND LIGHT AND POWER COMPANY
MAIN OFFICE
12 NO. BROADWAY, NYACK, N. Y.
TEL. 5000
OFFICE HOURS: WEEK DAYS - 8 A.M. TO 5 P.M. SAT. - 8 A.M. TO 12 M.

LOCAL OFFICES
HAVERSTRAW TEL. 2125
PEARL RIVER TEL. 2090
SPRING VALLEY TEL. 0
SUFFERN TEL. 1064

	DATE OF READING	METER READINGS PRESENT	METER READINGS PREVIOUS	USED K.W. HRS.	ROOMS OR WATER H.P.	CURRENT MONTH'S CHARGE CAPACITY	CURRENT MONTH'S CHARGE ENERGY	UNPAID BALANCE	APPLIANCES AND OTHER CHARGES
GAS									
ELEC.	SEC. 22	2881	2440	441*	7	$ 1.40	$ 2.044		

PLEASE NOTE THAT YOUR AVERAGE RATE PER KW. HR. THIS MONTH IS LESS THAN 5¢

JOHN JOHNSON
MAIN ST
SUFFERN N Y
500-480

See reverse side for rates

This Bill is now Due. Your cancelled check is sufficient evidence of payment.
* Receipt will not be mailed unless requested.

ROCKLAND LIGHT AND POWER COMPANY

DECEMBER 1931

TOTAL AMOUNT DUE

2184*

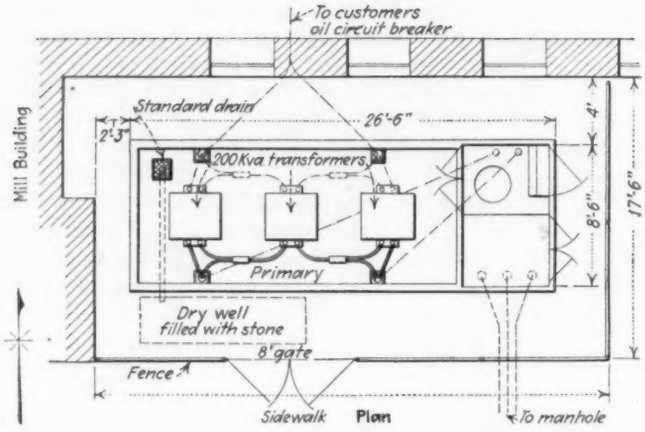
ALWAYS RETURN THIS STUB WITH YOUR PAYMENT

JOHN JOHNSON
MAIN ST
SUFFERN N Y
500-480

If you remit by mail, please address to our local office.

Typical bill starting at 9 cents per kilowatt-hour averaged less than 5 cents

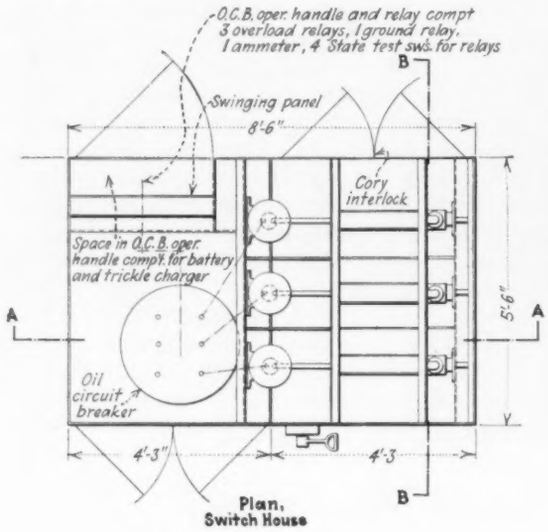
Metal-Clad Substation for Restricted Mill Yard

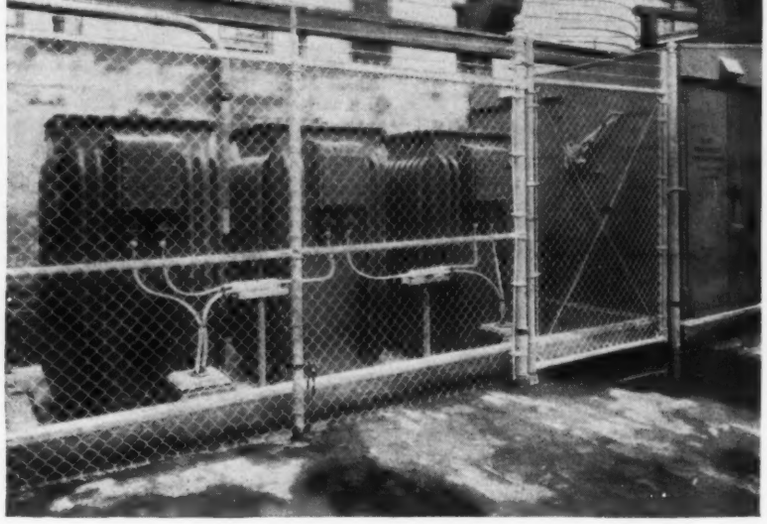


600-kva. bank and control house occupy 225 sq.ft.

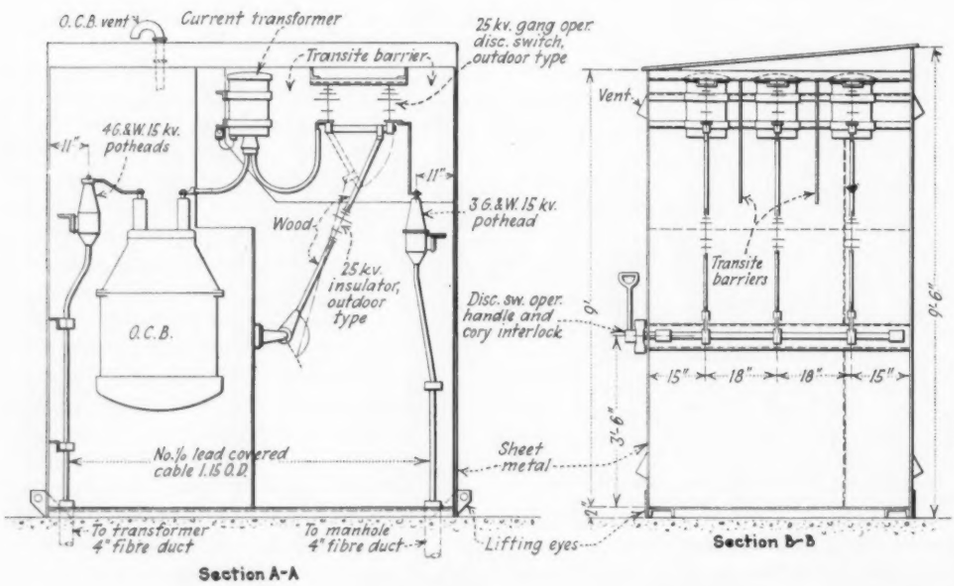
Underwriters' requirements for industrial substations located within 25 ft. of the nearest building led the Narragansett Electric Company, Providence, R. I., a subsidiary of the New England Power Association, to design a compact metal-clad unit for such service, combining ease of erection with safety in operation. As shown in the one-line diagram of a typical layout of

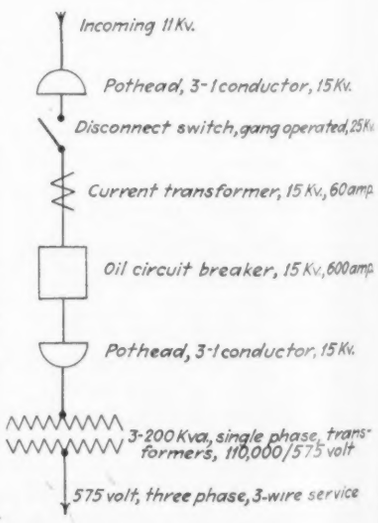
Barriers segregate circuits and equipment in control house





Metal-clad assembly affords complete fire and accident protection




Incoming 11 Kv.
Pothead, 3-1 conductor, 15 Kv.
Disconnect switch, gang operated, 25 Kv.
Current transformer, 15 Kv., 60 amp.
Oil circuit breaker, 15 Kv., 600 amp.
Pothead, 3-1 conductor, 15 Kv.
3-200 Kva, single phase, transformers, 110,000/575 volt
575 volt, three phase, 3-wire service

Main wiring reduced to simplest terms in metal-clad unit

three 200-kva. transformers supplied by a single feeder, the 11-kv. side includes the incoming cable potheads, primary "disconnects," current transformers, oil circuit breaker and pothead-type power transformers. These reduce the voltage to 575 for distribution through the plant. Switching and control equipment are housed in a metal-clad inclosure of the standard "control-house" type. A typical layout for such a housing provides for servicing the breaker through hinged doors in front of the breaker compartment. The back of the compartment is provided with a fixed and swinging panel protected by a hinged door for easy access to the switch-operating mechanism and to the control and metering devices. A front view of these panels shows the accessibility and compactness of this arrangement.

Industrial plants served by these substations are usually shut down at night. Condensation on insulating material after shutdown endangers the insulating qualities of this equipment. To insure reliability of service under these conditions, the "disconnects" and current transformers are built for outdoor service with their voltage rating increased from 11 kv. to 25 kv. The disconnecting switches have their operating handles accessible outside for greater safety of operation.

A system of key interlocks provides the following safeguards:

The "disconnects" must be locked (whether in the open or closed position) when the breaker is closed.

Disconnecting-switch compartment doors open only when "disconnects" are open and close only when "disconnects" are locked.

With "disconnects open" the oil circuit breaker is made safe for servicing and testing.

Erection is reduced to placing transformers and switching unit on their bases, making cable splices and mounting potheads.

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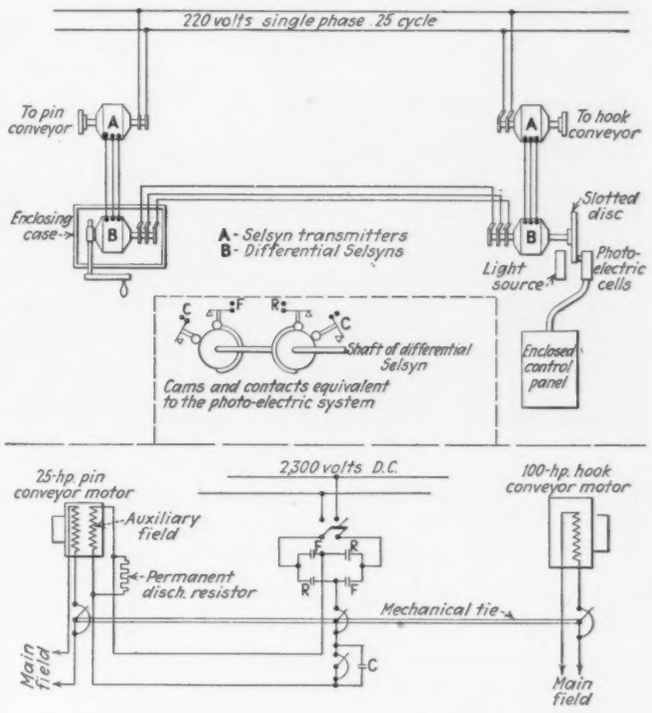
Synchronizing Conveyors by Photocells and Selsyns

By W. B. SNYDER
Industrial Engineering Department, General Electric Company

A steel plant in Youngstown, Ohio, has a pin-type conveyor carrying coils of rod away from a mill and delivering them to a hook conveyor. The coils rest on pairs of pins spaced 10 ft. apart on the pin conveyor; the hooks receiving the coils are similarly spaced. It is necessary that a hook arrive at the point of transfer at the same time that a pair of pins arrive, so that each coil may be safely transferred to a hook. Furthermore, the conveyors must be so arranged that the hook conveyor may be stopped and the pin conveyor run backward, yet both conveyors must automatically return to the proper relationship whenever they are both again started in the forward direction. This requirement precludes a common drive for both conveyors, which otherwise would have been used to insure proper synchronization.

The rather simple equipment illustrated in the accompanying sketch was recommended as a solution to the problem. Selsyn generators were geared to the two conveyor motors in such a manner that each generator would make exactly one revolution for each 10 ft. of travel of the respective conveyors. This gear ratio was chosen to insure that the only point at which the two Selsyns could be synchronized would be such that a hook was opposite a corresponding set of pins. The stators of the two Selsyns were connected to a differential Selsyn driving a slotted disk between a light source and a photo-electric cell; the photo-electric relays were arranged to control an auxiliary field of one of the conveyor motors.

The equipment is so arranged that when the two conveyors are synchronized properly the auxiliary field on the pin conveyor motor is de-energized. If the conveyors move out of synchronism slightly, the auxiliary field on the pin conveyor motor is energized in one direc-



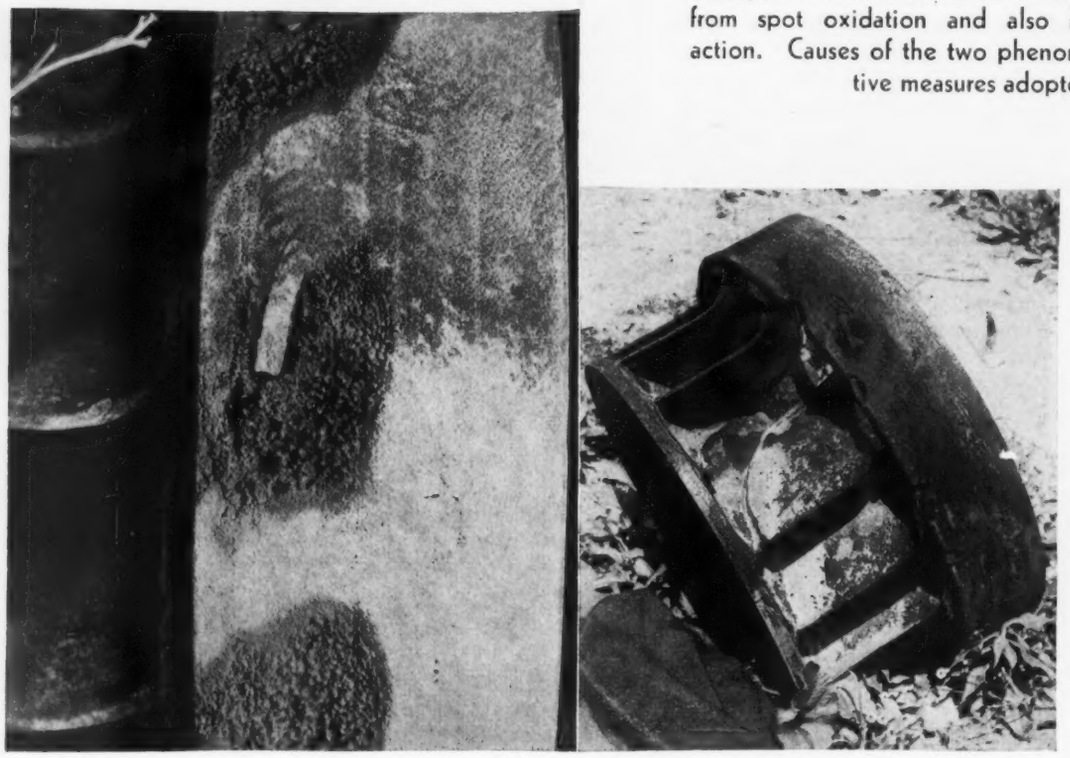
Features of control that synchronize delivering and receiving conveyors

tion or the other, depending on whether the pin conveyor is ahead or behind the hook conveyor. If the amount of correction thus obtained is not sufficient, and the conveyors tend to move further out of synchronism, a rheostat in the auxiliary field of the pin conveyor motor is short circuited, increasing the corrective effect.

A second differential Selsyn is mounted in a case out in the mill and is provided with a hand crank so that the operator can bring the two conveyors back into synchronism, if they drift out because of slippage or stretch in the drive. The field rheostats for the two motors are so arranged that turning one rheostat handle will change the speed of the two motors in approximately the same proportion, and will at the same time vary the strength of the auxiliary field, so that aproximately the same percentage correction can be obtained at top as at bottom speed.

Pitting of Hydraulic Turbine Runners

Examples of installations that exhibit corrosion pits from spot oxidation and also from electrolytic action. Causes of the two phenomena and corrective measures adopted.



By
ALBERT H. MYERS
Representative of Stone & Webster, Inc. Milwaukee, Wis.

Steel and cast iron runner which lasted only eighteen months

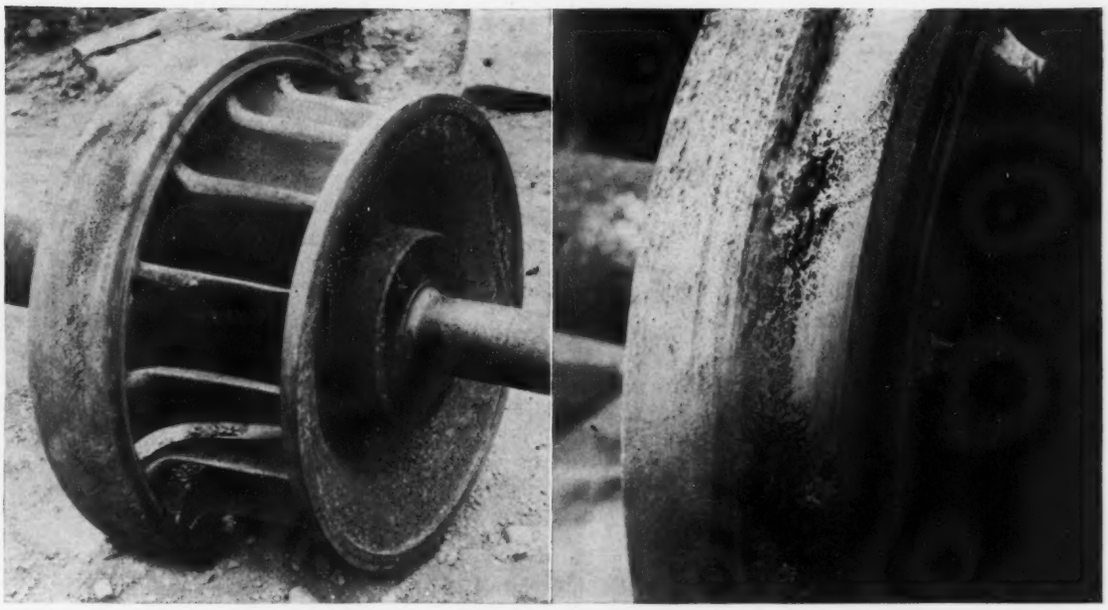
The first runners consisted of steel plate vanes with cast-iron end bands. The enlargement shows that the pitted areas are localized where the steel and cast iron join. No corrosion has taken place on the steel vanes themselves, although they become loose after only six months' operation.

PITTING of hydraulic turbine runners is of at least two varieties: One due to electrolytic action accentuated by impure water or stray electric currents; the other due to faulty or, at times, imperfect design of the turbine runner discharge passages in conjunction with the draft tube. In the former case the pitted areas are generally found at the runner band or largest diameter, while in the latter case the pitted areas take place on the surfaces of the runner vanes.

Corrosion of iron and steel is not uniform on turbine runners, but takes place in small areas where the action is so great that holes or depressions are produced which are called pits. Corrosive action does not take place equally upon metal surfaces, and as a result the penetration occurs more rapidly over one area than another. According to the electrolytic theory, pitting is due to inequalities in the composition of the metal or adjacent metals which makes some portions of the structure more electropositive than others. The current flows from one spot on the metal through the water to another spot and then back through the metal to the first spot. This action causes one place on the metal to disintegrate faster than the adjacent areas, the metal being most susceptible to corrosion where the density of the metal is non-uniform or where dissimilar metals are in direct contact with each other.

Direct pitting of hydraulic turbine runners is caused by water voids at the surface of the runner vanes, which permit the liberation of oxygen from the water and its immediate attack on the metal of the vanes. Such pitting may be found at both the entrance edges and the discharge portions of vanes of low specific speed runners. Pitting occurs at the entrance edges of runners of low specific speed owing to relatively high velocities and is caused by over-gate or low-gate positions of the turbine guidance vanes. On runners of medium specific speed direct pitting is generally found on the under side of the discharge portion of the vanes and is due to the reduced volume of water at low-gate positions not completely filling the passages between the runner vanes. As the water leaves the under side of the vanes voids are caused, with the resultant attack upon the metal of the vanes.

Foundry scale upon the runner vanes or a coat of enamel is known to resist minor attacks of direct pitting action. Ordinarily the tendency of a column of water is to remain continuous, but at low-gate openings, or when the construction of the water supply conduit is such as to set up a vortex or whirl, the whirl will be carried through the turbine to the draft tube discharge. In case of excessive draft head the water column within the draft tube will make and break, often causing serious direct corrosion of the discharge portion of the runner vanes. No one particular type of draft tube is perfectly suitable for all turbine installations. It is gratifying to note that recent laboratory experiments have brought to light considerable information pertaining to combinations of turbine settings and draft tubes which will tend to eliminate direct pitting at least at the discharge portion of turbine runner vanes.



Electrolytic corrosion of runner

Integral cast-iron runners were tried to avoid the electrolytic pitting caused by dissimilar metals in the first. But after two years' service electrolysis did not greatly reduce. It is interesting to observe that more corrosion occurred on the shaft-key side of the runner than on the other.

The accompanying illustrations show extreme cases of pitting upon the runners of several turbines operating since 1914 and illustrate the two types of pitting occurring simultaneously on a medium specific speed runner in a single installation.

The original runners installed were constructed of steel plate vanes formed to shape and then cast integral with a cast-iron hub and band. The mechanical stability of this type of construction was not very great as it was necessary to replace the original runners after approximately eighteen months of operation. The replacement consisted of integral cast-iron runners. The water in the river upon which the power station is located contains hydrogen sulphide, which has a very corrosive effect; in this particular case possibly accentuated by stray currents from the generators passing through the turbine shaft and runner vanes to the runner band.

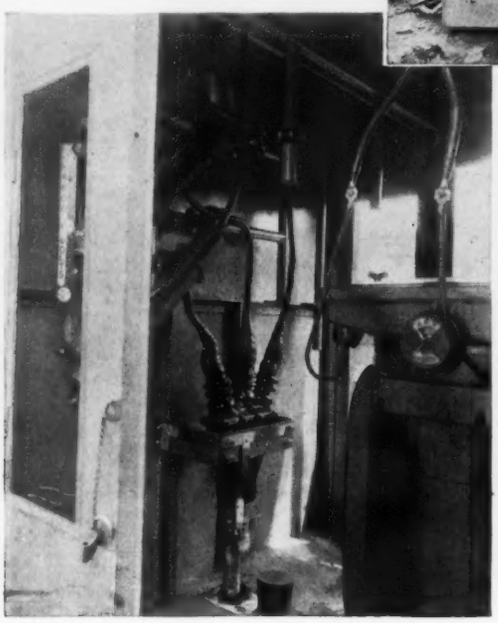
The hydraulic portions of the units have been partly redesigned to give a 10 per cent increase in power over the original capacity and new runners installed made of a very close-grained cast iron. Runners constructed of manganese bronze would probably solve the corrosion problem due to the unfavorable condition of the river water. However, the owners of the power station have not agreed to the additional expenditure involved for bronze runners. When data on the present runners are available direct comparison with the previous runners may be somewhat difficult owing to the fact that a 10 per cent increase in capacity will increase the water velocities in the passages retained from the original design and so induce additional pitting.

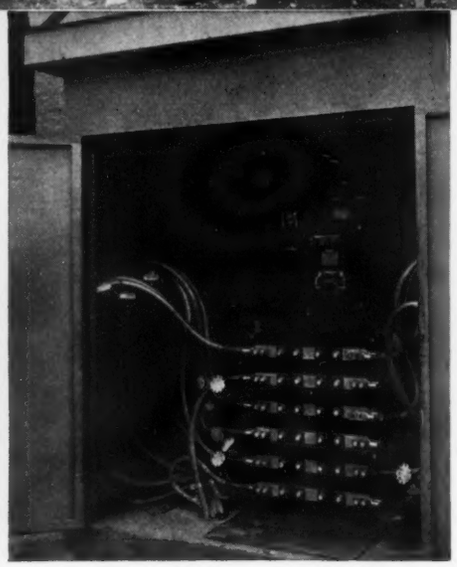
Direct pitting of runner

Not all of the corrosion on the under side of the vanes was due to electrolysis. Probably the greater part was caused by direct pitting due to water voids at the discharge portions of the runner vanes caused by improper draft tube design and turbine setting. There was no corrosion of the head-cover or curb-ring surfaces adjacent to the runner. This runner was removed from operation at the end of two years when the power obtainable from it was reduced 25 per cent. Arrows point to blocks of wood wedged in the runner vanes which were partially the cause of the reduction.

Network Transformer Kiosk

These distribution assemblies are used by the Detroit Edison Company in an area which is being served by a network that cannot with exactness be termed experimental, but which is furnishing experience that will be a determinant in deciding manners and methods of further utilization of the network idea. Rather than invest money in vault installations that may later be revised in design and location the distribution centers were set up as shown. The kiosk is divided into two parts, the large of which contains the transformer and the primary entrance and the other, at the end, tightly closed and dusproof, containing the network protector.





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Ultraviolet Reflection Factors

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

The designer of equipment or installations for dual-purpose lighting, combining ultraviolet radiation for health with light for seeing, is handicapped by lack of materials for efficient transmission or reflection of biologically active ultraviolet radiation. Many metals reflect this radiation to some extent, but only a few are of value for use in dual-purpose lighting fixtures; of these, aluminum and chromium are probably the best.

Diffuse spectral reflection factors of various materials are presented herewith as obtained by a colleague, A. H. Taylor, by a method which integrates the reflected radiation. Since λ2,967 is the wave length of the mercury spectrum which is most effective in producing erythema and also appears to be approximately the most effective in preventing and curing rickets, most of the reflection measurements have been made at this wave length. In most cases only a single specimen of each kind has been measured.

Material	Reflection Factor at λ2,967 Per Cent
Chromium plate on copper	58
Gold leaf (commercial)	32
Etched aluminum	82
Aluminum, mill finish	33
Same aluminum, surfaced on lathe	78
Aluminum foil	74
Aluminum wall-paper	82
Aluminum paint, amyl-acetate binder	65
Aluminum oxide paint, sodium silicate	60
Photographic paper, glossy	33
Cold water paint, Devoe kalsomine (white)	35
Cold water paint, Sherwin-Williams white decotint	42
White lead paint, flat	27
Imitation parchment, white	28
Imitation parchment, oiled	4–8

Oil paints are of limited value in dual-purpose lighting because of high absorption of the ultraviolet by the oil. Cold or hot water paints and aluminum paints appear to be the most satisfactory ones available at present. The principal pigments which can be used in the latter are barytes, magnesium oxide or carbonate, precipitated chalk, white lead, whiting and aluminum oxide. While all of these are fairly satisfactory for ultraviolet reflection, not all of them can be used in paints.

Diffusely transmitting media commonly used with ordinary light sources usually absorb practically all radiation in the spectral range from λ2,800 to λ3,100. Most of the special glasses, having good transmission factors for this region, will solarize (diminish in transparency

to ultraviolet) when used with the more powerful artificial sources of ultraviolet, such as the "Mazda" sunlight lamp. The principal exceptions are vitreosil (fused quartz) and Corex "D" glass. The latter is available in thin flat sheets with a pebbled surface and has a transmission of 50 per cent at λ3,000.

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READERS' FORUM

Sunrise Interruptions Attributed to Ionization of Heaviside Layer

To the Editor of the ELECTRICAL WORLD:

In a transmission plant it was noticed that the horn-shaped lightning arresters at the plant very often spilled over at sunrise. Obviously, as in the cases described in the October 10, 1931, issue in the article "Interruptions to Lines Concentrated at Sunrise—Why?" it was a matter of over-tensions which occurred just at sunrise. Nothing definite is yet known of the physics of this phenomenon. But I should think that the occurrence might be explained in the following manner:

It is well known that there is always an electrical potential gradient between the earth and the higher strata of air. The tension gradient runs about perpendicular to the earth. We can imagine the tension distribution in the atmosphere as similar to that of a chain insulator, except that it is not, of course, so even. Now the rising sun has an "ionizing" effect on the upper strata of the air (cf. the "Heaviside stratum" known through various phenomena connected with wireless telephony). This "ionizing" is, as it were, a relatively sudden short circuit of these strata. As in the case of short-circuit of some of the links in the above-mentioned chain insulator, so also the ionizing of the upper strata of air causes an increase in the tension gradient of the lower strata which are not ionized, until the balance is restored in time by a new field of distribution. Now this temporary increase in tension gradient might conceivably, as in thunderstorms, cause insulator flashovers. In order to explain these occurrences by experiment, it would be well to measure, at different times of the day, the potential distribution in the vicinity of the system where trouble occurs. Probably such a measurement would show that the potential gradient is at its maximum at sunrise.

Dr. A. MENGE,
President of the Bayernwerk A.G.
Munich, Germany.

[This is the letter mentioned by Mr. George in his letter to the editor appearing in the December 26, 1931, issue. In replying to Dr. Menge he further says: "Probably the unusual stress on the insulators at sunrise would not be high enough to cause a flashover with the ordinary factors of safety available with good insulators, but on a long line there are likely to be one or more defective units. We know that insulator leakage is a maximum at this time of day due to fog and dew, particularly after a season of dry and dusty weather."—EDITOR].

Hydro vs. Steam Costs

To the Editor of the ELECTRICAL WORLD:

In the Readers' Forum column of the January 16 issue of ELECTRICAL WORLD was printed a letter written by H. H. White criticising the December 12 abstract of the paper entitled "Economics of Water Power vs. Steam Power," by George Orrok, consulting engineer, New York City.

The policy of the ELECTRICAL WORLD of inviting and printing full discussions on both sides of any and all questions is of real benefit to both the public at large and to the professional engineer. Certainly it is the wish of all of its readers that this policy be maintained. Contributing to that purpose, it therefore becomes necessary to call attention to the fact that Mr. Orrok's paper is an able presentation of a cross-section of the economics of water power vs. steam power in the United States.

While some slight differences of opinion might possibly exist, such as, for example, whether it would be a little more conservative to set up an added reserve of, say, 1 or 1½ per cent for steam plant obsolescence and depreciation, compared with the 12½ per cent fixed charges for the hydro stations, or perhaps add a fraction of a mill to the "other operating charges" for steam plants, nevertheless we must regard the article as a masterly statement of the facts as they exist and not as recently referred to, viz.: "It is unfortunate that any engineer should publish his personal views on a question like this."

Mr. Orrok's presentation is distinctly not a personal view. On the contrary, it is a comprehensive professional report reflecting a commanding knowledge of the subject.

In contrast with this, we note that H. H. White's letter opens with the accusation of "personal views" and closes with a very special case giving "production cost in hydro plant as 0.18 mill per kliowatt-hour, production cost in steam plant 3.89 mills per kilowatt-hour," together with the statement, "This is proof in one case at least that steam power costs actually 21½ times more than hydro power."

We should accent the words "this is proof in one case at least" and call attention to the fact that the entire letter should be regarded as a special interpretation and by no means as a true cross-section of the status of water power vs. steam power in this country. The figure 0.18 mill might well be labeled operating costs only.

If we are to deal with special cases, then with each specific project must be considered the contemporary controlling economic facts. Such economic facts are not static. They are subject to change with time.

There are some water powers which can be economically developed now. They do not, however, constitute an important portion of the power situation of today in the United States. They cannot be built at present to produce power for anything like 0.18 mill per kilowatt-hour. Even at the better sites power will cost several times this figure. Some of them will be built with successful results. There are others which may become subject to development, but the advancement in steam power practice cannot be ignored.

F. C. CZARNECKI.
33 West 39th Street,
New York City.

BOOK REVIEWS

Electrical Equipment

By H. W. Brown. McGraw-Hill Book Company, New York. 586 pages, second edition, illustrated. Price, $5.

This book has been entirely rewritten and enlarged to make it broader in scope. It fills the gap between college texts and practical handbooks in that it discusses the available electrical equipment, its use and its performance or applications. It covers the utility and manufacturing plant applications of circuits, motors, instruments, heating and welding and discusses the engineering aspects of a choice and assembly of equipment for each application.

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Die Entwicklung des Fernsehens

By F. Fuchs. "German Museum, Discussions and Reports" Series, third year, Vol. 5; 30 pages, 19 illustrations. Published by the VDI-Verlag, Berlin N.W. 7. Price paper, 1 mark.

In a form that does not presuppose technical knowledge on the reader's part this little pamphlet gives a remarkably clear review of the beginnings and subsequent steps in the development of television. The story is carried forward from the invention of the selenium cell and, later, of the scanning disk by Nipkow; the narrative takes up the chief problems encountered and the means adopted for their solution.

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Noise and Vibration Engineering

By S. E. Slocum. D. Van Nostrand Company, Inc. 167 pages, illustrated. Price, $2.75.

Because of the increasing agitation against noise any book on this subject is welcome. Unfortunately, however, it dispatches the subject in only 158 text pages devoted to chapters on transmission of elastic ground waves, properties of vibration dampers and insulators, machinery insulation, sound deadening and acoustic correction, economic aspects of noise abatement, mathematical groundwork and other topics. The bibliography of seven pages should be helpful in corraling previously published information. So far as the electrical industry is concerned it would be desirable to have future editions of this or other works on the subject include a more exhaustive compilation of noise preventive and remedial methods that are practical and economical.

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Bibliography of Bibliographies in Electrical Engineering

Edited by Katherine Maynard, Vail librarian Massachusetts Institute of Technology. Special Libraries Association, 11 Nisbet Street, Providence, R. I. Price, $1.50.

A 156-page compilation of the electrical engineering committee of the Special Libraries Association, covering subject bibliographies from book and periodical sources from 1918 to 1929 inclusive, embracing over 2,500 entries and pointing the way to about 25,000 articles or books. About one-third the entries are in French or German. By grouping together references to the recent literature in the whole field of electrical engineering, the object has been to do for the engineer what has already been done for the physicist and chemist by similar publications. The arrangement is alphabetical under topical headings, with extensive cross-references.

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Electric Wiring for the Farm

By F. B. Wright and B. B. Robb. Published by New York State College of Agriculture at Cornell University, Ithaca, N. Y. 122 pages, 121 illustrations.

Planning and executing the wiring and lighting job for the American farm is comprehensively detailed in Bulletin 204 of the Cornell extension series. Photographs and simple diagrams show any farmer what he can do and should do to get the benefits of electric service cheaply, adequately, effectively, durably and safely. Home, barn, yard, garage, field use of power are all treated and the basis established for full-use installation.

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Everyman and His Common Stocks

By Lawrence H. Sloan. McGraw-Hill Book Company, Inc. Price, $2.50.

That the purchase and holding of common stocks should not be based on guesswork and hunches has been amply demonstrated in the past two years. That certain systematic planning, study and knowledge can be and should be applied to this as well as to any type of investment is shown by Mr. Sloan and he also tells how this should be done. "Everyman and His Common Stocks" is a timely contribution in helping the rank and file investor get the foundation laid for his future estate at what appears to be the market's low point.

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Stoker Equipment and Furnaces

N.E.L.A. Serial Report No. 159. Price to members, 75 cents; to non-members, $1.

This rather exhaustive report of 66 pages is replete with data from 21 companies on 98 stoker-fired boiler units installed since 1926 and contains operating experience from 38 companies. Statements from sixteen manufacturers are included. The tabular and plotted data are particularly illuminating in showing comparative practices and trends over the past few years. One of the tables shows extensive design data for the 98 installations covered and includes such unit values as (1) square feet of saturated heating surface per square foot of stoker and grate area and per cubic foot of furnace volume, and (2) ten-hour maximum combustion rates in pounds per hour per square foot of grate area and B.t.u. per hour per cubic foot of furnace volume. Trends in maximum steaming capacity, maximum combustion rate, preheated air temperatures and maximum grate area are plotted. Distribution of heating surface between boilers, economizers, air preheaters and furnace walls is also shown. The character of 33 automatic combustion control installations is presented in tabulated form with some influencing conditions.

Men of the Industry

H. A. Kidder New President of United Engineering Trustees

Harry A. Kidder, superintendent of motive power of the Interborough Rapid Transit Company, New York, has been elected president for 1932 of the United Engineering Trustees, joint agency of the four founder engineering societies. Mr. Kidder is chairman of the finance committee of the Professional Engineers' Committee on Unemployment and a fellow of the American Institute of Electrical Engineers, which he represents on the administrative board of the American Engineering Council. He is past-chairman of the New York section of the Institute and a past-president of the New York Electrical Society.

Harold V. Coes, consulting management engineer of Ford, Bacon & Davis, and Col. Arthur S. Dwight, president of Dwight & Lloyd Companies, were named vice-presidents. Dr. Alfred D. Flinn, director of the Engineering Foundation, will serve as secretary, and Clifford P. Hunt, vice-president of the Chemical Bank & Trust Company, as treasurer.

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ARTHUR D. SPENCER has been appointed treasurer of the Detroit Edison Company to succed Samuel C. Mumford, who, on account of ill health, has retired after many years of service to the company.

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JOHN J. O'CONNELL, manager of the Pittsfield (Mass.) Electric Company for the past year, has also been appointed manager of the Lee Electric Company, both being affiliated with the Western Massachusetts Companies. CARL WURTZBURG, for some years manager of the Lee company, has been named resident manager and vice-president. GEORGE W. LAWRENCE, president of the Western Massachusetts Companies, has been elected president of the Pittsfield and Lee companies.

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San Diego Utility Elects New Officers

Election of the following officers has been announced by W. F. Raber, president San Diego Consolidated Gas & Electric Company. L. M. Klauber, vice-president in charge of operation; M. B. Fowler, vice-president and treasurer; A. E. Holloway, vice-president in charge of sales, and J. A. Cannon, secretary.

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Worthington Pump Elects Wilson and Searle Vice-Presidents

C. E. Wilson, for the past nine years general sales manager of the Worthington Pump & Machinery Corporation, Harrison, N. J., has been appointed vice-president in charge of industrial relations. Mr. Wilson began his career with Worthington in 1899 as a salesman in the Chicago office. In 1905 he was appointed sales manager of that office and later was made assistant general sales manager in charge of all territory from Cleveland to Denver. In 1918 he became assistant general sales manager in charge of foreign business,

where he remained until 1923, when he was made general sales manager.

Clarence E. Searle, for the past seventeen years general representative in charge of sales for the Allis-Chalmers Manufacturing Company, has been appointed vice-president in charge of sales. Mr. Searle became associated with the Allis-Chalmers organization in 1908, prior to which time he was with the Western Electric Company and the Fort Wayne Electric Works (a division of the General Electric Company). After one year as a sales representative in the Milwaukee office of Allis-Chalmers he became district manager of that office in 1910. He filled that position until 1915, at which time he was made general representative in charge of sales,

a position he held until his present appointment.

Charles N. Barney, for the past fourteen years secretary and general counsel, has been appointed secretary, treasurer and general counsel and William H. Baumes, treasurer for the past fourteen years, has retired at the age of 61.

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CLARENCE J. HUNTER has been elected vice-president in charge of sales of the Dampney Company of America, Boston, Mass. Mr. Hunter was formerly Philadelphia district manager and more recently general sales manager.

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SIR CHARLES GORDON, G.B.E., president of the Bank of Montreal, has been appointed a member of the board of directors of Montreal Light, Heat & Power Consolidated, to succeed Sir H. Montagu Allan, C.V.O., resigned.

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DR. DORSEY A. LYON, director of the Utah engineering experiment station at the University of Utah, was elected president of the Engineering Council of Utah at a recent meeting held in Salt Lake City. Dr. Lyon is also president of the Utah Society of Engineers. He succeeds H. C. Goodrich as president of the council and will serve during the year 1932.

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A. W. ALTHOUSE, assistant merchandising manager of the Southern California Edison Company, Ltd., has been appointed manager of the Alhambra district to succeed A. I. Whitehead, who has assumed the duties of manager of the central division. Mr. Althouse has had extensive experience in both district and merchandising activities of the Edison organization since he joined the company in 1919.

E. F. Kelly New Vice-President of Illinois Company

Edward F. Kelly, who was elected vice-president of the Central Illinois Public Service Company, as announced in the February 6 issue of the ELECTRICAL WORLD, enters upon his new duties with an unusual background of utility operating experience. Mr. Kelly was graduated with the degree of B.S. in mechanical engineering from the Massachusetts Institute of Technology with the class of 1907. After a two years' shop course following his graduation he was employed by the New York Edison Company for a period of four years as power salesman, and at the time he left that company was assistant manager of the power department.

In 1913 he entered the service of the Central Illinois Public Service Company as power salesman and shortly thereafter became assistant manager of the company's commercial department, which position he held for three years. In 1916 Mr. Kelly was transferred to the Twin State Gas & Electric Company as commercial manager, which

position he was occupying when he enlisted in 1917 in the United States army for World War service.

In July, 1919, Mr. Kelly re-entered the service of the Central Illinois Public Service Company as manager of Division M, located at Mattoon, Ill., which position he held until 1928, when he was transferred to Springfield as assistant to vice-president, in charge of safety, public relations and commercial departments.

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FREDERICK KRUG, vice-president and general manager of the Porto Rico Railway, Light & Power Company, San Juan, has been elected president of the Chamber of Commerce of Porto Rico. Mr. Krug has for long been active in the Chamber of Commerce of Porto Rico, which is affiliated with the Chamber of Commerce of the United States. He is also president of Puerto Rico Service, Inc., a business men's organization which promotes the establishment of new industries on the island, Porto Rico exhibitions on the mainland, tourist propaganda, etc. He is also a member of the Governor's Insular Unemployment Relief Committee, and several other organizations devoted to civic welfare.

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B. M. RICHARDSON has been elected chairman of the Iowa State Board of Railroad Commissioners.

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R. B. TENNEY, JR., engineer of the Texas Power & Light Company, Dallas, Tex., rceently has become consulting engineer at Dallas for the Power Cost Engineering and Appraisal Corporation, San Antonio, Tex.

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C. S. BAGG, general manager of Montreal Light, Heat & Power Consolidated since early in 1929, has been appointed vice-president. Mr. Bagg has been identified with the company in various executive capacities for the past 25 years. He will continue as general manager.

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J. M. GAYLORD, recently appointed chief electrical engineer of the Metropolitan Water District of Southern California, has been a Westerner for 40 years and is recognized widely as an authority on electrical engineering in its relation to water problems in the Western states. He formerly was chief electrical engineer of the United States Bureau of Reclamation and more recently was superintendent of hydro generation for the Southern California Edison Company, Ltd. He received his technical education at Throop Polytechnic Institute at Pasadena, the predecessor of the present California Institute of Technology, and the Massachusetts Institute of Technology.

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K. M. IRWIN, who had been mechanical engineer of the United Gas Improvement Company since 1927, was appointed assistant to the vice-president in charge of mechanical engineering of the Philadelphia Electric Company. Mr. Irwin entered the U. G. I. employ in February, 1919, as an assistant to the electrical engineer and held that position until he was appointed mechanical engineer. Prior to that he had been employed by B. F. Sturtevant Company, Stone & Webster and Perry Barker, consulting engineer of Boston. Mr. Irwin is a graduate of the Sheffield Scientific School, Yale University, and has been active for years in the American Society of Mechanical Engineers. For nine years he was a member of the prime movers committee of the National Electric Light Association and he was also chairman of the prime movers committee of the Pennsylvania Electric Association.

G. H. Bucher Vice-President of Westinghouse International

George H. Bucher, who was elected vice-president and general manager of the Westinghouse Electric International Company, as announced in the February 6 issue of the ELECTRICAL WORLD, has been identified with the Westinghouse interests since 1909, when he

joined the organization as a graduate student. He was graduated from the Pratt Institute in Brooklyn in both steam and machine design and electrical engineering. In 1911 he was transferred from the graduate student course at East Pittsburgh to the export department in New York. On April 1, 1920, he was appointed assistant to the general manager of the Westinghouse Electric International Company and July 1 of the following year he was appointed assistant general manager, which position he held until his recent appointment.

Mr. Bucher is a member of the American Institute of Electrical Engineers. He will make his headquarters in New York.

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OBITUARY

J. R. COWLEY, superintendent of the power plant at Saskatoon, Sask., died recently, after a lingering illness, at the age of 49. Mr. Cowley had been in charge of the power plant in Saskatoon since 1918. Two years ago, when the new government power plant was opened in that city, he was appointed in charge, which position he held until his death.

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SAMUEL T. CARNES, prominently connected with early electrical developments in Memphis, Tenn., died of pneumonia, January 26, at his home in that city following a few days' illness. Mr. Carnes' business interests were wide, embracing banking, cotton and paving, as well as public utility activities. He was 82 years of age.

Trade News

Pfeil Heads Frigidaire Staff in New England Area

John S. Pfeil has been appointed manager of the Frigidaire Sales Corporation of New England, with headquarters at Boston, succeeding H. W. Newell, whose appointment as vice-president at the Dayton headquarters of the manufacturing organization was announced in the ELECTRICAL WORLD last week. Mr. Pfeil has served the Frigidaire organization in many capacities since its early days, progressing from salesman through various executive posts in the marketing field to the assistant general managership of the New England branch. The following additional appointments have been announced by the New England organization: Assistant manager, T. A. Farrell; general sales manager, H. A. Valencourt; district sales managers, E. H. Richardson, F. W. Smith and C. E. Skoglund; sales manager public utility division, L. S. Kimball; retail sales manager, J. H. Taylor; Boston commercial sales manager, J. T. Shaughnessy; sales promotion manager, J. F. Cain; comptroller, L. W. Retzel; distribution manager, G. W. Brett; service manager, F. M. Long, and assistant to the manager, F. F. Doten.

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The Ohio Brass Company reports for the year ended December, 1931, a net loss after taxes and depreciation of $113,773, against a net profit of $1,817,518 in 1930.

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The Sparks-Withington Company of Jackson, Mich., announces that it has placed on the market the Sparton electrical refrigerator, claiming the advantages of simplicity, long life and quality, elimination of fan belts and economy in the use of electric current.

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The Reliance Electric & Engineering Company, Cleveland, announces that the Cincinnati office has been moved to 2905 Carew Tower, with J. L. Van Nort in charge. H. A. Holmes has been given charge of the Toledo office. L. M. Dunning has been transferred to the Cleveland district office.

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On December 15 the Canadian Fairbanks-Morse Company, Ltd., paid to common-stock holders of record November 30 a dividend of 25 cents per share. Regular quarterly distributions of 50 cents per share were made on March 14 and on June 15 last, none since.

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The Crocker-Wheeler Electric Manufacturing Company reports for the year ended December 31 net loss after depreciation, interest and other charges of $228,346, against net profit of $143,973 in 1930.

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Reed & Prince Manufacturing Company of Worcester, Mass., has been licensed by the Dardelet Threadlock Corporation to manufacture and sell bolts, nuts and screws threaded with the Dardelet self-locking thread.

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Exclusive Canadian manufacturing and sales rights on the entire line of the Wagner Electric Corporation of St. Louis, Mo., with the exception of its automotive equipment, were acquired recently by the Sangamo Company, Ltd., of Toronto, Ont., the largest manufacturer in Canada of electric meters. A new subsidiary of the Sangamo company, known as the Wagner Electric Manufacturing Company, Ltd., has been formed to manufacture the Wagner lines acquired and quantity production will get under way at once. The principal line to be produced under the Canadian agreement will be small electric motors.

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Announcement has been made by the U. S. Electrical Manufacturing Company of the appointment of the Maintenance Company, Inc., New York City, as sole distributor for the New York metropolitan area of all U. S. autostart asbestos-protected ball-bearing equipment.

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James H. Drew announces the opening of an office in the Midland Bank Building, Cleveland, to represent manufacturers of electric railway material, steam railroad material and motor-bus equipment throughout the United States and Canada. Mr. Drew will represent the Westinghouse Electric & Manufacturing Company in the sale of line material and rail bonds in Ohio, Michigan, Indiana, Illinois and Kentucky.

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Karl Anton Piez, formerly New England sales manager of Curtis Lighting, Inc., Boston, Mass., has been appointed manager of the fixture department of the Crooker Company, Providence, R. I. He has been succeeded at Boston by Harry Le Roy Nicol, formerly resident engineer at Buffalo, N. Y., for the Curtis organization.

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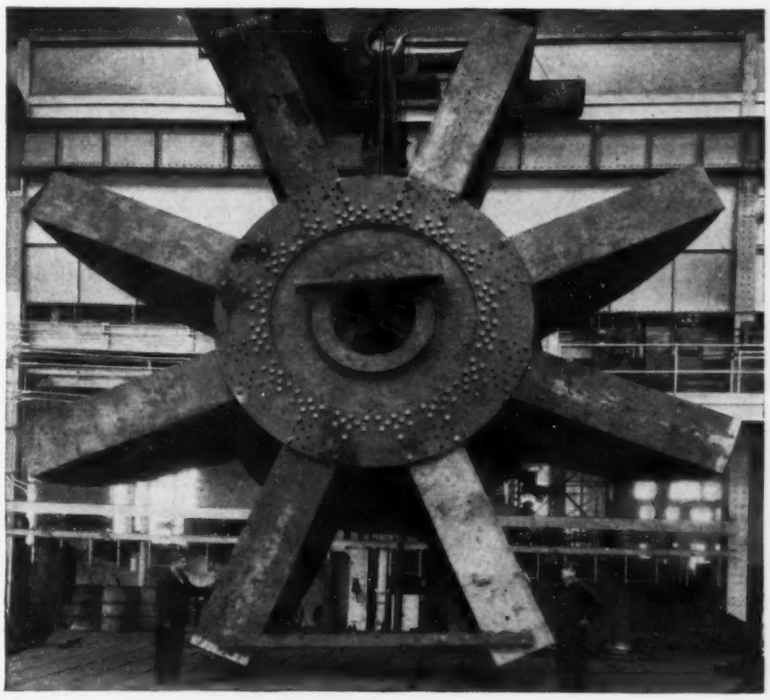
EQUIPMENT FOR DNEIPER RIVER PROJECT

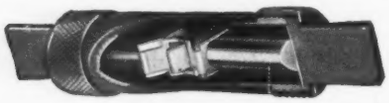


The 90-ton bearing bracket, colloquially known as the "spider," for a huge waterwheel generator which the General Electric Company is building for the Soviet goverment's hydro-electric plant on the Dneiper River.

New Equipment Available

Improved Renewable Fuse

A new principle of fuse protection, said to have met with much success, has been developed in the design and construction of the "AE" renewable fuse. The abutment contact between the terminal pin and renewal link, which is obtained by screwing up the cap, eliminates the use of nuts, bolts and



washers. In operation the expansion of the copper pins against the renewal link insures maximum conductivity. The blade, end plate and long pin, a unit of copper together with the corresponding short renewal link, results in a cool operating fuse. True alignment of the blades at all times is assured by the truss effect created in the mechanical assembly of the fuse. The fuse is a product of the Associated Engineers Company of Chicago.

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Pole-Type Transformers Protected Against Lightning

Lightning arresters for distribution transformers, connected to the incoming high-voltage lead and the grounded lead on the low-voltage side, the usual ground connection for arresters being omitted, are announced by the General Electric Company. They can be installed in modern pole-mounted transformers without change; steel transformer tanks fabricated within the past two years or more have been designed with such units in mind.

The opinion has held for some time, and facts reported on at the recent A.I.E.E. winter convention in New York, that transformers would be practically immune from lightning troubles if the arresters were connected directly to the primary terminal and the grounded secondary of the transformers. Almost complete immunity from lightning failures and a reduction in fuse blowing are claimed, as well as a lowering of installation costs. In the new scheme the tank is left ungrounded in accordance with customary practice, but the secondary must be thoroughly grounded.

Laboratory tests demonstrated improvement in protection, and the experiences of several operating companies with this scheme have confirmed the tests. Additional field tests made last year with artificial lightning, in co-operation with the Associated Gas & Electric Company, near Ithaca, N. Y., further verified the results. These arresters, completely assembled and especially designed for this application, are being produced for 2,400- and 4,800-volt service. They are made of "Thyrite."

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Single-Unit Connectors Self-Equalizing

A new single-unit wire connector which may be attached to through wires with one hand is announced by the W. N. Matthews Corporation, St. Louis, Mo. This connector, known as the "Univise," consists of a clamping jaw and unit inseparable from the bolt so that no parts may be lost or cross-threading forced. These connectors are said to be stronger than any slotted bolt type of connector, since 52 per cent of the original bolt is retained. All parts are made of 90 per cent copper content. "Univise" connectors are made in seven sizes, from which several hundred different combinations of wire connectors may be made. Other features include equalized and distributed pressure in contact grooves and avoidance of off-set pressure.

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Centralized Remote Control of Valve with Thrustor

A "Thrustor"-operated valve, enabling centralized remote control of gases or liquids under pressure, is announced by the General Electric Company. It is available in sizes ranging from 2 to 12 in. for from 125 to 600 lb. pressure per square inch and is designed for general industrial applications such as in oil refineries, paper mills, pulp mills, candy manufacturing plants, sandpaper mills, etc., particularly where centralized remote control is desired. The new valve may also be readily installed in place of hand-operated valves.

In operation the "Thrustor," a self-contained power unit consisting of a motor controlling an improved hydraulic cylinder, applies pressure to the valve to open or close it. A spring is used to return the "Thrustor" to its original position. In addition, no overload protection is necessary in the motor circuit of the "Thrustor," since it can go to the extreme limit of its travel without overloading the motor. No limit switches are necessary for controlling the opening or closing of the valve.

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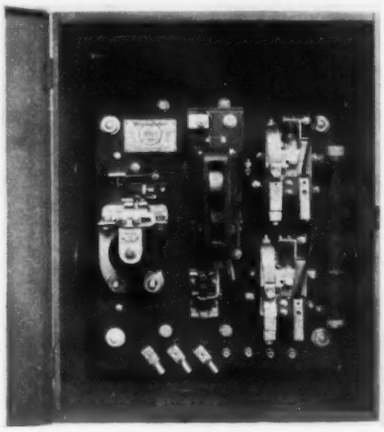
D. C. Magnetic Starters for Mining Service

A new line of d.c. magnetic starters designed especially for mining service is announced by the Westinghouse Electric & Manufacturing Company. Explosion-tested starters range from 1 to 25 hp. ratings and are inclosed in a rolled steel cylindrical case which is exceedingly easy to take apart. The standard mining controllers of the non-explosion tested type are totally inclosed in a dust-proof welded sheet-steel cabinet with an overlapping hinged door and are built in sizes from 3 to 75 hp.

The individual pieces of electrical apparatus making up these starters incorporate all the essential features required in the great majority of d.c. magnetic controllers for mining applications, namely: Controller starts and brings motor up to full speed in a predetermined, definite length of time any load the motor is capable of starting and accelerating. Overload protection is provided which will permit high starting or high momentary peak loads and at the same time trip instantaneously in case the starting load or peak load exceeds the commutating limit of



the motor. In addition to the above features the same overload relay protects the motor from overheating.

All individual pieces of apparatus have a high reserve capacity. The line contactors have an arc-rupturing capacity capable of opening a dead short circuit. The several contactors used are the 101-SM, 102-SM and 104-SM, which have arc-rupturing capacities of 3,000, 5,000 and 7,500 amp., respectively, at 600 volts d.c. The accelerating contactor designated as the type "AT" has a continuous current carrying capacity of 300 amp. and is used on all sizes of starters.